

Title of the doctoral program

Computer and Control Engineering

Title of the research activity

ICT for Urban Sustainability

Short description of the research activity

The increasing number of the population in urban areas create high demand and cause hard problems, like difficulty in waste management, air pollution, traffic congestion and inadequate infrastructures. Those problems degrade the quality of life in cities, being a threat to the health of the citizens, and are typically related with multiple stakeholders. Information and Communication Technology can be exploited to monitor and control what happens at specific city area for taking effective countermeasures. The research will investigate a smart city system to help local government and citizens themselves monitor what currently happens in the city. The designed architecture of the system will use sensor networks able to capture city condition like temperature, air and water pollution, traffic situation, humidity, etc. The system will be deployed in a mobile and static network installed on different entities, like the bicycles available in the bike-sharing service, the public transportation vehicles and fixed spots in order to acquire real-time and diffused information on the whole urban area. The huge amount of data will be analyzed and made available on a platform that will constitute the source of data to develop mobile applications useful to help the citizens and the stakeholders in the management of the actions to reduce the air pollution or the traffic congestion, and optimizing the use of the urban resources.

The research will study and develop an hardware system and a software tool able to monitor, control and handle urban problems such as air pollution, traffic congestion, water quality, and so on.

The research will design the whole architecture of the system composed of different types of nodes, fixed and mobile. Mobile nodes could be deployed into public transport vehicles and public bicycles. Fixed nodes will be installed in some critical points, like the most crowded crossroads.

Mobile nodes will consider the best trade-off between cost and performance in order to design a low-cost node useful to massively deploy them within the urban area. Hundreds of hazardous gases have been identified in the environment. However, among these gases, six pollutants (CO, NO₂, SO₂, ground level O₃, Particulate Matter, and Pb) are the most dangerous and will be considered as the starting point for the development of the sensor nodes. In case of mobile node, the localization of each node becomes an essential constraint, in order to realize an ubiquitous real-time monitoring system: the integration of a GPS module, which delivers accurate position and time information, will be considered in order to guarantee a pervasive system. Particular attention will be paid in evaluating the scalability of the system, in order to maximize the number of possible nodes. Data will be exchanged among the nodes and toward a gateway exploiting low-power wireless data routing protocols or a telecommunication network. The adoption of a data logger will be investigated and evaluated.

Data will be processed on the low-level module of the network and then will be collected by distributed gateways and a central server according to a hierarchical architecture that must guarantee their reliability and the availability of the system.

The foreseen activity will consider also the analysis of the huge amount of data with the goal to realize a platform of data acquisition and evaluation, useful to develop mobile applications to be installed in portable or automotive devices, with the goal to display a dashboard containing useful information such as air pollution, traffic condition or parking availability, and to elaborate those information to make some decision useful for the user citizen, e.g., the best path, as far as the traffic is considered, the area with a high or low level of pollution, the zone with available parking, etc.

Scientific responsible (name, surname, role, email)

Maurizio Rebaudengo, Associate Professor, maurizio.rebaudengo@polito.it

Number of vacancies for XXXI cycle (3 years program)

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Specific requirements (experiences, skills)

The proposed research involves multidisciplinary knowledge and skills (e.g., computer network and advanced programming).

Website of the research group (if any)

www.cad.polito.it