Future Wireless Cities Workshop: Smart City Surveillance Running on Vehicles

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As the complex social ecosystems, cities and urban areas accommodate half of the world's population, resulting in immense pressure on the quality of life. In such urban environments, residents, industries and governments are experiencing unprecedented challenges regarding sustainable development, healthcare, environment, safety and public services. The challenges attract enormous efforts to pursue the assistance of technology advancement for efficient city management and governance. In order to meet the urgent technological demands, various Smart City initiatives are invested on information and communication technologies to seek sustainable solutions to address the growing issues on urban living. When the cities are endowed with intelligence, a wealth of useful information will be made available to assist the people, who live or travel in cities, on planning their daily lives. For example, smart city systems are able to notify residents about traffic congestion and accidents, trouble spots and avert crimes, and the potential communities for flooding during storm, etc. Among various aspects covered by the concept of Smart City, smart living leveraging outdoor surveillance events in cities plays a critical role on providing assistance and convenience for urban residents.

Most current Smart City projects with outdoor surveillance underway mainly rely on fixed sensing infrastructures to harness the vast amounts of surveillance information in urban areas. The sensing infrastructure could be either general monitoring equipment (e.g., CCTV cameras) or professional sensing instruments (e.g., air quality sensors). However, it may not be convenient and affordable for many cities to install and maintain the large-scale sensing infrastructure due to the high costs of economic and human efforts. Even when dedicated sensing infrastructures are deployed, the effectiveness of their usage will probably be affected by urban re-planning/temporary constructions and severe weather conditions. For example, a video surveillance system may be blocked by nearby construction sheds. In addition, due to the static nature of strategic deployment, these fixed sensing infrastructures have limited geographic coverage and will rapidly become obsolete. The ever-growing urban issues in current society exhibit urgent needs on fine-grained urban surveillance events, not relying on dedicated sensing infrastructures.

Toward this end, we propose a novel paradigm for smart city surveillance running on vehicles leveraging the diverse vehicle-mounted sensing capabilities. Particularly, it would crowdsource real-time and fine-grained urban surveillance events, including images, infrared radiance, wind turbulence, light environment, etc., and thereby facilitate residents' planning for their daily lives. Such a paradigm is motivated by two major observations on current vehicles: *1) High dynamics and density of vehicles:* Vehicles have now become the indispensable transportation tool, which provides a convenient and efficient way to commute and travel in people's daily lives. Nowadays they could achieve an unprecedented level of spatial and temporal coverage in urban areas. *2) High penetration of vehicle-mounted sensing and networking capabilities:* The rapid evolution of vehicle techniques enables various sensing capabilities (e.g., front/rear view cameras, Doppler radars, infrared sensor arrays, temperature sensors, and light sensors) to be integrated into vehicle systems for safe driving, such as collision avoidance and lane change assistance, etc. In addition to the on-board sensors, the recent wave of sensor-rich and Internet-enabled off-the-shelf smart devices (e.g., smartphone and EDR) opens the door for engaging ordinary individuals to participate in the urban surveillance. Furthermore, these sensing devices can be easily interfaced with the smartphone and share information through readily available wireless communication infrastructures (e.g., 3G/4G service or WiFi networks), resulting in a comprehensive and valuable view for smart city usage. To validate the proposed paradigm, a vehicle-based crowd sensing testbed leveraging various vehicle-mounted sensing devices (i.e., cameras, infrared sensor arrays, air pressure sensors, light sensors, etc.) and existing communication (i.e., cellular or vehicular networks) infrastructure will be built for outdoor surveillance in real urban environments.

Background. Dr. Yingying Chen is a Professor with the Electronic and Computer Engineering Department of Stevens Institute of Technology. Her expertise is in Cyber Security & Privacy, Mobile Computing & Sensing, and Smart & Mobile Health. Dr. Hongbo Liu is an Assistant Professor with the Department of Computer, Information and Technology of IUPUI. His expertise is in Cyber Security & Privacy, Mobile Computing & Pervasive Wireless Localization Systems, and Smart Grid. Dr. Yan Wang is an Assistant Professor with the Computer Science department in Binghamton University. His expertise is in Mobile Computing, Pervasive Sensing, Cyber Security & Privacy, and Wireless & Sensor Networks. **Funding.** We would like to be partially reimbursed for attending the workshop.