Chapter 16
UAV-Based Smart Environmental Monitoring

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ABSTRACT

In the context of digital governance, manmade activities will have the most impact on the environment. The concept of internet of things (IoT) is much more profound, supposedly having an impact on the way environmental sampling of data takes place. The cost benefits of unmanned aerial vehicles (UAVs) as alternate to satellite or high-altitude platform system (HAPS) is established as these are more flexible, mission specific, and versatile. UAV in sensor network context and communication relaying as well as data harvesting application is explored. Proposal to upgrade environmental laws and implementing network infrastructure security and cyber insurance for HetNets involving UAVs and environmental monitoring will be covered as well.

INTRODUCTION

IoT Data Sampling and Smart Environment

The Industrial Revolution 4.0 is revolutionizing our world and its future. The future holds the key for connecting the home, work place, industry and the rest of the concept of a Smart City. In the next few years, an estimated 500 billion devices will be connected to the internet. There is the obvious energy

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usage, but also the impact on natural IoT connects physical world to cyber world or computer world where, objects can have smart capabilities, and can make their own decisions. Design of technology infrastructures using fast and efficient delivery of services and data aims to cover the Digital Divide that is a need of the day. Here the natural consequence of evolution of architectures in the digital landscape requires interactivity and increased efficiency for betterment of the quality of life of residents. Climate change and environmental sustainability has assumed importance in the lives of the digital citizens as it impacts health, work life patterns, city operation, communication and socio-cultural contexts. The most profound effect of man-made activity is on environment.

It is aimed to explore the impact of transportation including man-made activities on environment using fixed sensors spread in an urban environment. Air pollution monitoring systems have low three-dimensional and time-based resolution using only a few measuring sensors with small footprint. This is because of limited resources using lower time resolution hence the huge sampling intervals.

UAVs aid in spatially efficient handling of environmental data from smart sensors. These can also house various sensors as well as collect data from the same. It is proficient as it can be in close proximity to data collection hardware in a variety of terrain. The data can be relayed remotely to a centralized location and processed using power efficient UAV to UAV and UAV to Ground links. The UAV platform and payload are discussed in following two configurations 1) fixed sensor on ground and 2) air borne sensor on board the UAV.

In the former context, the idea of information relaying is explored where data is stored and forwarded or processed and forwarded for various sensor configuration. It is explored with request to the data relaying portion and tests are discussed in detail to enable COTS development in the context of Technology Adoption for developing countries. The most important part is the communication payload because that is where most of the energy is utilized and where most of the operational problems like control, connectivity and application specific issues occur. For communication sensors, information is relayed to neighbor nodes to transfer the data but for transferring data. However, for other nodes it needs to be in the transmission radius referred to as the transmitting range. Finally, the relayed data is transferred to sink node which is the end node in wireless sensor network. Here all the traffic from different nodes gather at a point and from there, it is transmitted to the server.

In the later context, the architecture and present scenario for onboard scientific testing is normally taking place on board the Data Acquisition (DAQ) and Ground Control System (GCS). As in the wireless sensor networks, UAVs can also sense and monitor different parameters such as temperature, pressure, humidity, pollution indexes etc.

A single UAV is good but with limited coverage, it cannot cover the whole area of interest. UAV monitoring is usually associated with UAV swarms because swarms can provide larger coverage area. Hence the idea of multiple aerial platform deployment is considered. However, this concept is still in its infancy. There are issues concerning the autonomous operation and control of devices in 3D space. The tracking and accurate alignment is required for guidance as well as communication. Where the communication system is itself a payload this becomes more crucial.

Finally, the idea of merging risk transfer mechanism for upgradation of the scheme is attractive for future agriculturists and environmentalist is explored in some detail.