Self Organization Algorithms for Mobile Devices

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INTRODUCTION

Self-organization is a phenomenon in nature which has been studied in several areas, namely biology, thermodynamics, cybernetics, computing modeling, and economics. Systems exhibiting self-organization have well defined characteristics such as robustness, adaptability, and scalability, which make self-organization an attractive field of study for two kinds of applications: a) maintaining the communication among mobile devices in wireless networks, and b) coordination of swarms of mobile robots.

In ad hoc networks, there is not necessarily an underlying infrastructure in which the nodes can maintain communicated with other nodes; so due to this feature, it is necessary to provide efficient self-organization algorithms for routing, managing, and reconfiguring the network.

Furthermore, self-organization in nature provide clear examples about how complex behaviors can arise from only local interaction between entities, namely the ants colony, feather formation, and flock of birds. Based on the above mentioned examples, several algorithms have been proposed to accomplish robot formations using only local interactions.

Due to resource constraints in mobile devices, self-organization requires simple algorithms for maintaining and adapting wireless networks. The use of resources for establishing robot formations can be reduced by improving simple rules to accomplish the formation. This article first presents a brief overview of several works developed in ad hoc networks; then, delves deeper into the key algorithms; and finally, challenges arising in this area are discussed.
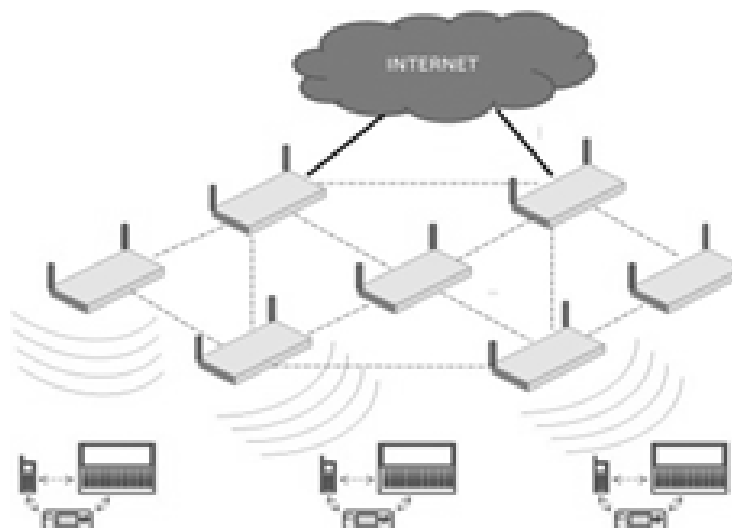
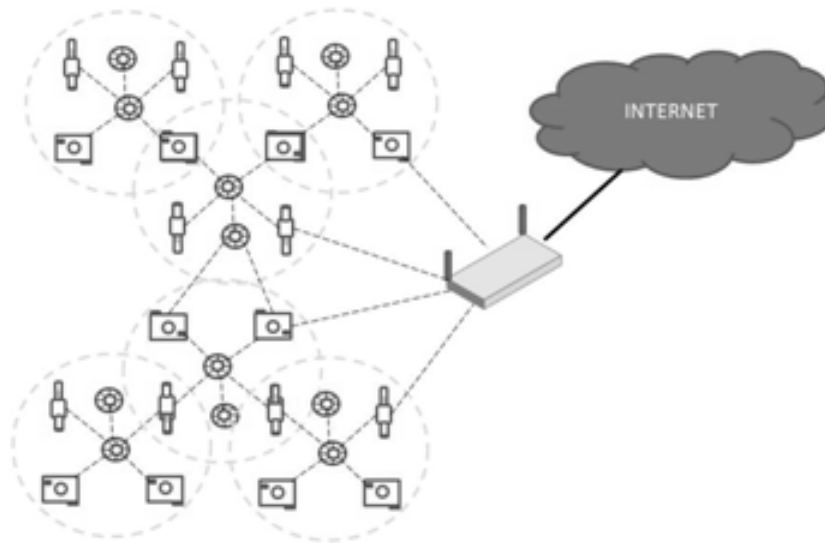*Figure 1. Wireless mesh network*
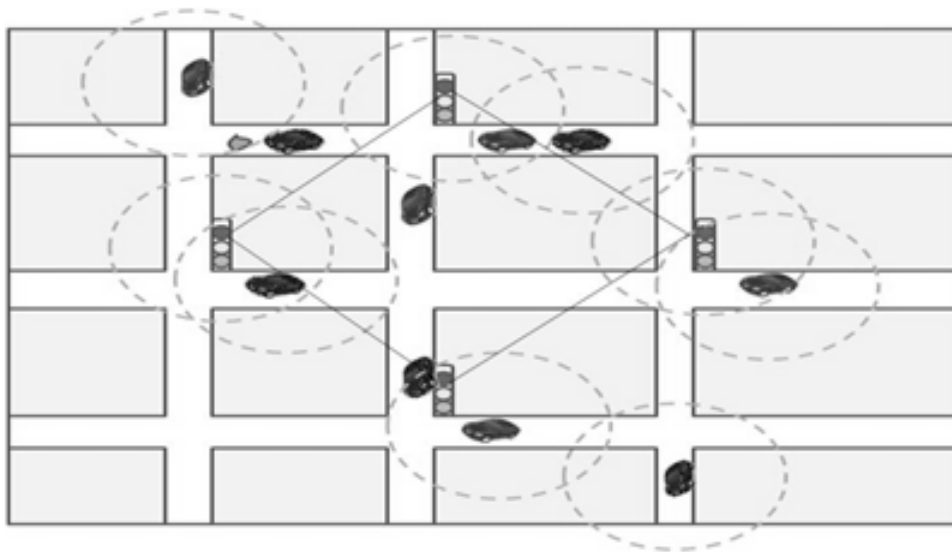
Figure 2. Wireless sensor network

Figure 3. Vehicular ad hoc network

BACKGROUND

Self-organizing networks can be classified as follows:

- Mobile Ad hoc Networks (MANET). In this kind of network the nodes are mobile devices operating under energy consumption constraints.
- Wireless Mesh Networks (WMNs). The backbone of the network consists of mesh routers (which have reduced mobility) allowing the communications between mobile mesh clients. (Figure 1).
- Wireless Sensor Networks (WSNs). They are composed of a large number of sensor nodes widespread

on a field; they are used for collecting information on the environment and transmitting such information to themselves or to a base station (Figure 2).
- Vehicular Ad Hoc Networks (VANETs). These networks use ad hoc communications for detecting obstacles on the road and emergency events by exchanging information obtained from the roadside or from other vehicles (Figure 3).

A common feature of these networks is the mobility of nodes; furthermore, there exists not always a relaying structure. These facts evidence the need for including within

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