WIRELESS WILDFIRE SENSOR NETWORKS

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1. INTRODUCTION

Sensor nodes can be used to monitor the environment autonomously and, through the use of their radios, communicate with neighbouring nodes. Nodes will forward each other's messages allowing any pair of nodes to communicate if there exists a chain of neighbours that includes them both. This Wireless Sensor Network (WSN) can be used for wildfire applications.

WSNs differ from existing remote sensing methods such as aerial photography and satellite imaging by providing high-resolution, autonomous data gathering. WSNs are also more fragile, being more prone to environmental hazards such as fire.

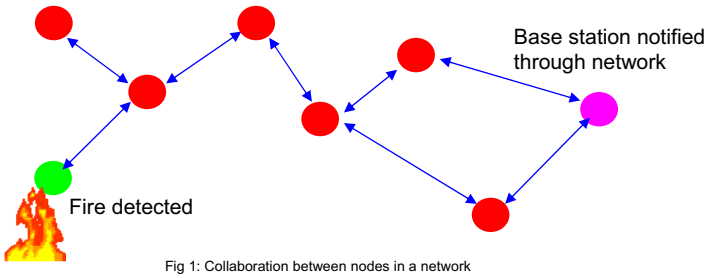

Fig 1: Collaboration between nodes in a network

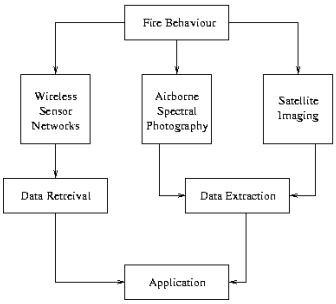

Fig 2: Comparison of techniques used to gather data.

2. WSN TECHNOLOGY

Each sensor node consists of a CPU, radio (with an approximate range of 500m), memory, power supply and sensors capable of detecting heat, moisture, wind, smoke, and more. Additional capabilities can be added, such as: solar panels, GPS, and loggers buried underground, capable of surviving fire.

We have three different members of a WSN: normal, Super, and Basestation. Super nodes differ from normal nodes by having greater radio range, longevity, and cost.

Basestations are part of the WSNs, but do not have sensors. Instead, they receive data from the rest of the network and provide a point of access for users. Most basestations will be connected to infrastructure such as the power grid and Internet.

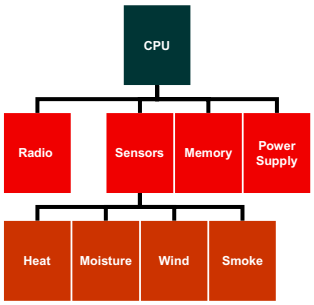

Fig 3: Sensor node components

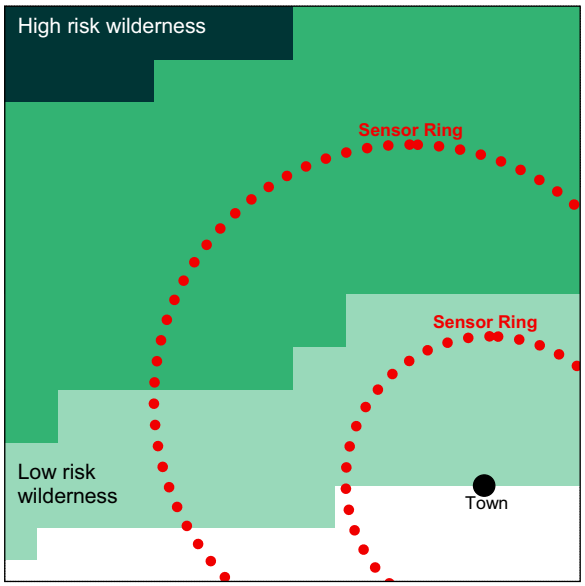

Fig 4: Early detection system

3. SCENARIO

We consider a town surrounded by bushland at risk of wildfire. Rings of sensors are deployed around the town, which can be used as an early detection system, as well as a means for gathering fine-scale fire/weather data. Each ring has several Super nodes which increase the reliability of each ring.

We have several means to recover data from the sensors. Firstly, we can position the nodes to facilitate inter-ring communication and provide transmission paths back to a basestation located at the town. Secondly, we can have separate basestations for each ring, possibly located at ranger stations. Lastly, we can have "Collectors", (personnel or aircraft) that can collect data as they patrol past nodes.

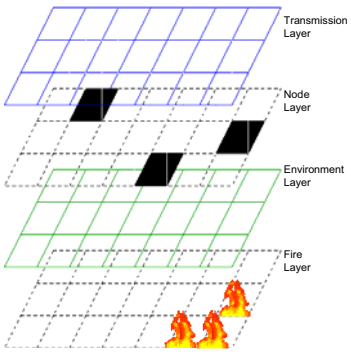

Fig 5: Modelling layers

4. MODELLING

We model the system of sensor networks in order to perform experiments in a virtual environment that would otherwise be impossible in real-life due to cost, danger, and lack of control.

We use a multi-layered model that interact to simulate the overall system. Each layer consists of small automata that interact to capture the behaviour of that component.