A Review Paper on Study of Mote Technology: Smart Dust

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Abstract— Smart Dust is a tiny dust size device which has a lot of extra-ordinary capabilities. Smart Dust combines features like sensing, wireless communication capabilities, computing and autonomous power supply within volume of only few millimeters and at low cost. These devices are proposed to be very small and light in weight. Individual sensors in smart dust are often referred to as motes because of their tiny dust size. These devices are also known as MEMS, which stands for micro electro-mechanical sensors. Soon we all see Smart Dust used in varied application in all spans of life.

Key words: Autonomous, MEMS, Mote

I. INTRODUCTION

A wireless sensor contains spatially distributed autonomous sensors to monitor physical or environmental conditions like sound, vibration, temperature, pressure, motion or pollutants and to cooperatively pass their data through the network to a location also known as main location. The development of wireless sensor networks is motivated by battlefield surveillance which is a military application; today these networks are used in many industrial and consumer applications. The WSN is built of "nodes" whose size varies from a few hundred to several hundreds or even thousands. Each sensor network node consists of several parts: a radio transceiver with an internal antenna or either connected to an external antenna, a microcontroller and an electronic circuit for interfacing the sensors and an energy source, using a battery or an embedded form of energy harvesting. A sensor node varies in size from that of a shoebox to the size of a grain. The figure shows a network which use modes instead of sensor. In this paper, we present a several current WSN modes which is being compared and contrasted under a number of different parameters. The parameters which is to be compared and contrasted is processor used protocols, cost, expected lifetime, applications and their pros and cons. These motes can also be compared depending on the total power which is being consumed by different modules of the motes.

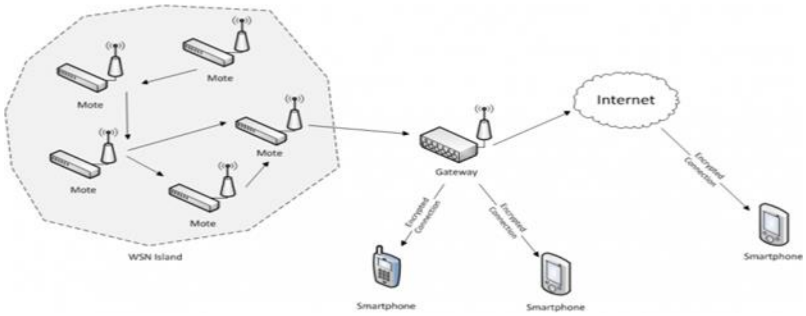

Fig. 1: Use of motes in Wireless sensor networks

II. CONCEPT OF SMART DUST

Smart dust will require both evolutionary and revolutionary advances in miniaturization and energy management. These advances will be aided by the progress in MEMS, which allow us to build small sensors, optical components, power supplies and microelectronics providing increased amounts of functionality in smaller areas with lower energy consumption Figure, shows the conceptual diagram of a smart dust mote. The power system consists of either a solar cell having a charge integrated capacitor for periods of darkness or a thick film battery. A variety of sensors which includes light, temperature, vibration, magnetic field and wind shear can be integrated on the mote depending on the task. An integrated circuit will provide sensor signal processing, communication protocol and energy management. A photodiode is used for optical data reception and two transmission schemes are being explored: passive transmission and active transmission.

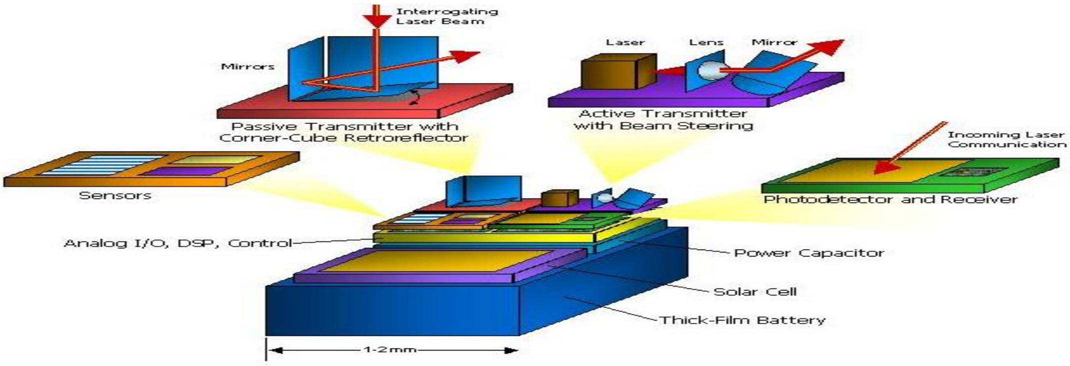

Fig. 2: Conceptual Diagram of Smart Dust

Because of the small size of mote, energy management is a key constraint of the design. Currently, the battery and capacitor can store about 1J/mm3 and 10mJ/mm3, while solar cells can provide 1J/day/mm2 in sunlight and 1-10 mJ/day/mm2 indoors.

III. FURTHER IMPLEMENTATIONS

1) The optical receiver for the smart dust project is going to be developed. The receiver senses incoming laser transmissions at up to 1Mbit/s, and a power consumption of 12µW. Although this is huge for continuous use in smart dust, it is a small figure for the download of small amounts of data.
2) For data transmission, the team uses corner cube retro-reflectors (CCRs) built using MEMS technology. CCRs are produced by placing three mirrors at the right angle to each other to form the corner of a box that having a silver coating inside. The key property of a CCR is that the light entering is reflected back along the When a light is shone into the CCR, it reflects back to the starting position. By modulating the position of one of the mirrors, the reflected beam is modulated and produces a low-energy passive transmission.
3) The analog-digital convertor (8bit), having an input range of 1V which is equal to the power supply. The converter consumes 1.8µW when sampling at that rate.
4) The latest smart dust mote, have a volume of 16cu mm. It takes samples from a photo-detector and transmits their values with the CCR and runs off solar cells path. For the smart dust system, the CCR is being made on a MEMS process having two vertical sides.

IV. APPLICATIONS OF SMART DUST

Environmental protection (identification and monitoring of environment pollution), habitat monitoring, military application (monitoring activities in areas which are not accessible, remains with soldiers and alert them to any poisons biological substances present in the air), indoor Environmental Monitoring and outdoor environmental monitoring.

V. CONCLUSION

This paper has presented a review of Smart Dust (a mote technology).For different motes, a series of five categories have been considered, namely processor and memory, protocols, cost, power consumption, their applications and also the pros and cons of this technology. In-Motes application has been developed for sensing acceleration variations in the environment. The application was tested in an area, road alike, for a period of four months.

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