What is Smart Dust?

Advantages &
Disadvantages

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Presentation glossary

- Smart Dust - devices are small wireless microelectromechanical sensors that can detect everything from light to vibrations.
- MEMS - microelectromechanical sensors which is one of the main component of technology.
- RAND and DARPA – corporations, that’s emerged the concept of smart dust.
- CCR - Corner Cube Retroreflector, the device for passive optical transmission in smart dust technology.
- RFID – radio frequency identification used in smart dust technology.
- TinyOS – is a component based operation system, most popular world operation system for low-power wireless devices.

Technology description

Smart Dust - devices are small wireless microelectromechanical sensors (MEMS) that can detect everything from light to vibrations. It is a tiny dust size device with extraordinary capabilities. It encompasses Nano-structured silicon sensor which can spontaneously assemble, orient sense and report on their local environment. This new technology combines sensing, computing, wireless communication capabilities and autonomous power supply within the volume of only a few millimeters. It is very hard to detect the presence of the Smart Dust and it is even harder to get rid of them once deployed. Smart Dust is useful in monitoring real world phenomenon without disturbing the original process.

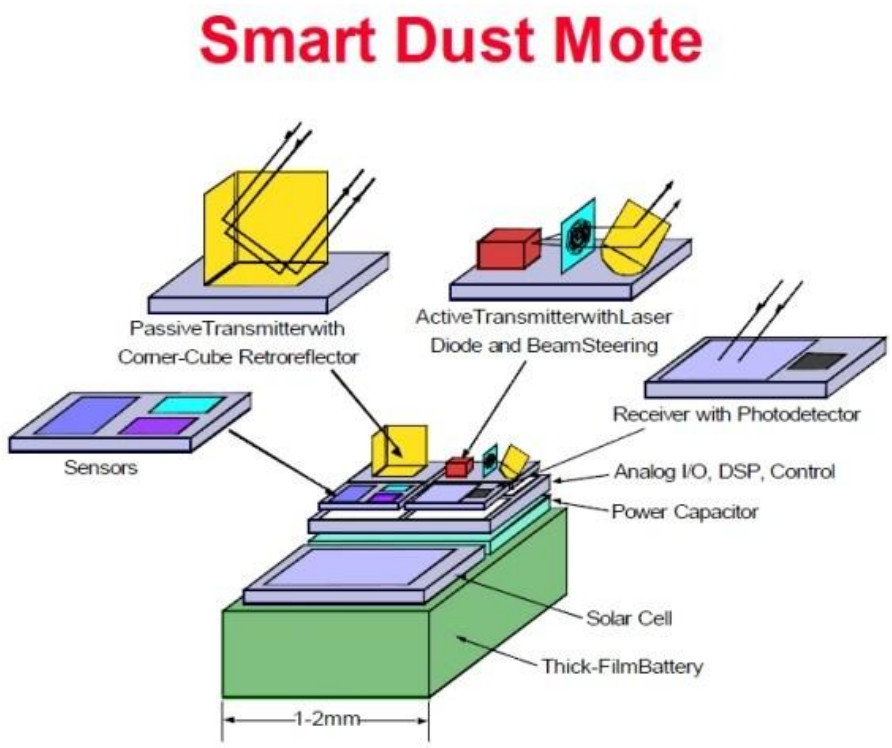
Technology description

The concepts for Smart Dust emerged from a workshop at RAND in 1992 and a series of DARPA ISAT studies in the mid-1990s due to the potential military applications of the technology. The work was strongly influenced by work at UCLA and the University of Michigan during that period, as well as science fiction authors Stanislaw Lem, Neal Stephenson and Vernor Vinge. The first public presentation of the concept by that name was at the American Vacuum Society meeting in Anaheim in 1996.

Technology description

The Key Components of Smart Dust:

- A semiconductor laser diode and MEMS beam steering mirror for active optical transmission.
- Corner Cube Retroreflector(CCR) for passive optical transmission
- Photodetector and receiver
- An optical receiver
- A signal processing and control circuitry
- A power source based on thick-film batteries and solar cells.



Methodology

Smart Dust motes are run by microcontrollers. These microcontrollers consist of tiny sensors for recording various type of data. Timers are used to run these sensors. These sensors do the job of collecting the data. The data obtained are stored in its memory for further interpretations. It can also be sent to the base controlling stations.

CCR, that comprises of three mutually perpendicular mirrors of gold coated polysilicon, has the property that any incident ray of light is reflected back to the source provided that is incident within a certain range of angles centered about the cubes body diagonal.

The micro fabricated CCR includes an electrostatic actuator that can deflect one of the mirrors at kilohertz rate.

Hence, the external light source can be transmitted back in the form of the modulated signal at kilobits per second. It can transmit to the bus only when the CCR body diagonal happens to point directly towards the bits, within a few tens of degrees.

Although a passive transmitter can be made more omnidirectional by employing several CCR”s oriented in different directions, at the expense of increased dust mote size.

State of the art and open issues

At the moment, many of the applications for smart dust are still in the concept stage. In fact, Gartner listed smart dust technology for the first time in its Gartner Hype Cycle in 2016. While the technology has forward momentum, there's still quite a bit to resolve before you will see it impacting your organization. However, it's important to pay attention to its trajectory of growth, because it's no longer the fodder of science fiction. We might not know when it will progress to the point of wide-scale adoption, but we certainly know it's a question of when rather than if.

In this presentation you can also see **advantages and disadvantages of smart dust.**

Advantages and disadvantages of smart dust.

Advantages

- Monitor crops in an unprecedented scale to determine watering, fertilization and pest-control needs.
- Monitor equipment to facilitate more timely maintenance.
- Identify weaknesses and corrosion prior to a system failure.
- Enable wireless monitoring of people and products for security purposes.
- Measuring anything that can be measured nearly anywhere.
- Enhance inventory control with MEMS to track products from manufacturing facility shelves to boxes to palettes to shipping vessels to trucks to retail shelves.
- Possible applications for the healthcare industry are immense from diagnostic procedures without surgery to monitoring devices that help people with disabilities interact with tools that help them live independently.
- Researchers at UC Berkeley published a paper about the potential for neural dust, an implantable system to be sprinkled on the human brain, to provide feedback about brain functionality.

Disadvantages

There are still plenty of concerns with wide-scale adoption of smart dust that need to be sorted out. Here are a few disadvantages of smart dust:

Privacy concerns:

- Many that have reservations about the real-world implications of smart dust are concerned about privacy issues. Since smart dust devices are miniature sensors they can record anything that they are programmed to record. Since they are so small, they are difficult to detect. Your imagination can run wild regarding the negative privacy implications when smart dust falls into the wrong hands.

Control:

- Once billions of smart dust devices are deployed over an area it would be difficult to retrieve or capture them if necessary. Given how small they are, it would be challenging to detect them if you weren't made aware of their presence. The volume of smart dust that could be engaged by a rogue individual, company or government to do harm would make it challenging for the authorities to control if necessary.

Cost:

- As with any new technology, the cost to implement a smart dust system that includes the satellites and other elements required for full implementation is high. Until costs come down, it will be technology out of reach for many.

Industry leaders and startups

The entities who have led the development of smart dust technology since 1992 and large corporations such as General Electric, Cargill, IBM, Cisco Systems and more who invested in research for smart dust and viable applications believe this technology will be disruptive to economies and our world.

The potential of smart dust to collect information about any environment in incredible detail could impact plenty of things in a variety of industries from safety to compliance to productivity. It's like multiplying the internet of things technology millions or billions of times over.

Since the components that make up these devices are 3D printed as one piece on a commercially available 3D printer, an incredible amount of complexity can be handled and some previous manufacturing barriers that restricted how small you can make things were overcome. The optical lenses that are created for these miniaturized sensors can achieve the finest quality images.

Bibliography

1. **Book:**

   Smart Dust: Sensor Network Applications, Architecture and Design

1. **Wikipedia:**
   https://en.wikipedia.org/wiki/Smartdust
   https://en.wikipedia.org/wiki/Radio-frequency_identification
2. **Other internet sources:**

   https://catchupdates.com/smart-dust/

   https://www.techopedia.com/definition/3155/smart-dust

   https://forbes.com/Smart-dust-information