MEMS Environmental and Bioterrorism Applications: Activity
Instructor Guide

Note to Instructor

This activity provides the participants an opportunity to explore current and future MEMS applications for Environmental and Bioterrorism sensing.   Participants should read the PK before doing this activity in order to get an understanding of sensing needs for these areas.

This activity is part of the *MEMS Environmental and Bioterrorism Applications Learning Module*:
•   MEMS Environmental and Bioterrorism Applications PK
•   **MEMS Environmental and Bioterrorism Applications: Activity**
•   MEMS Environmental and Bioterrorism Applications Assessment

Description and Estimated Time to Complete

This learning module provides an overview of how MEMS (MicroElectroMechanical Systems) are being used for bioterrorism and environmental sensing. The primary knowledge (PK) unit covered several current applications as well as a few applications being researched. In this activity you are to research a current or perspective MEMS application for environmental or bioterrorism sensing. In your research, learn how this device works and how it's used. Make suggestions on other applications for the device as well as possible improvements or extensions. Present your results in a presentation.

If you have not reviewed the PK unit *MEMS Environmental and Bioterrorism Applications*, you should do so before starting this activity.

Estimated Time to Complete
Allow at least two hours to complete this activity.

Introduction

Environmental and bioterrorism sensing has always been important. However, after certain cataclysmic events such as the Indian Ocean tsunami in 2004, 9/11, the prospect of human-caused climate changes, and the need for more energy sources, targeted sensing has become a necessity for individuals and governments. MEMS sensors can help protect and preserve life on earth as we know it by doing the following:

- Monitor weather and other environmental conditions, including agriculture and ecological concerns.
- Monitor energy, fluid, machinery, and other systems in factories, facilities, buildings and homes as well as the structures themselves.
- Sense transportation vehicles and related transportation infrastructure including roads, bridges, and equipment.
- Sense potential security and safety problems in buildings, factories, airports, and war zones (to name a few).

Activity Objectives and Outcomes

Activity Objectives
- Demonstrate your understanding of how MEMS can be used for environmental or bioterrorism sensing applications by researching a specific MEMS device and creating a presentation that describes it operation, applications, limitations, and other criteria.

Activity Outcomes
Develop a presentation that explains how your MEMS works and the advantages it offers to its specific applications.

Documentation

1. A presentation meeting the activity requirements listed below.
2. Answers to the Post-Activity Questions

NOTE: Be sure to include ALL sources and references to data and graphics.

Activity: MEMS for Environmental and Bioterrorism Applications

Procedure:

1. Using Internet sources, research one of the examples given in the primary knowledge unit or another MEMS application for environmental or bioterrorism sensing that you find interesting.

2. Using Power Point or other presentation software, create a presentation that includes the following:
    a. "The problem" (what is being sensed and why)
    b. Description of the MEMS technology including pictures
    c. Advantages of the MEMS over conventional sensing
    d. Limitations (if any)
    e. Possible improvements, enhancements for next generation MEMS
    f. Other applications for this particular sensor (if applicable)
    g. All references and sources

3. Answer the Post-Activity Questions

Post-Activity Questions

1. How can MEMS sensors be used to locate airborne toxins in the field?

2. How can MEMS sensors be used to monitor the effects of global warming at the north and south poles?

3. What are various ways that MEMS sensors can be anchored for environmental sensing?

4. What are various methods for making MEMS sensors mobile in the field?

Post-Activity Questions / Answers

1. How can MEMS sensors be used to locate airborne toxins in the field?
    Answers will vary. Answers should mention the eNose and other devices used to detect specific biologics in the air.

2. How can MEMS sensors be used to monitor the effects of global warming at the north and south poles?
    Answers will vary. Answers could include MEMS sensors that detect barometric pressure, atmospheric pressures, temperatures, particulates, etc.

3. What are various ways that MEMS sensors can be anchored for environmental sensing?
    Answers will vary. Possible answers are buoys (for oceans, lakes), buildings, towers, weights drums at the bottom of oceans, lakes, etc.

4. What are various methods for making MEMS sensors mobile in the field?
    Answers will vary. Possible answers are attaching MEMS to vehicles, incorporating them into clothing or helmets, or creating handheld devices.

Summary

MEMS technology is used for environmental and bioterrorism sensing based on perceived risk and need. Currently, the most common sensors are pressure (including flow rate and acoustical), temperature, radiation, chemical, and biological. These sensors can be coupled together and transmit data via wireless networks to sites where the data is analyzed.

References

- PK Unit: *MEMS Environmental and Bioterrorism Applications*

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