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ZIG BEE BASED VALCANO DETECTING SYSTEM (VDS)

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ABSTRACT

The main contribution of this project is the design of a robust sensor network optimized for rapid deployment during periods of volcanic unrest and provide real-time long-term volcano monitoring. The system supports UTC-time synchronized data acquisition with 1 ms accuracy, and is remotely configurable. It has been tested in the lab environment, the outdoor campus and the volcano crater.

KEYWORDS: Robust Sensor Network, Rapid Deployment, Volcanic Unrest. Real-Time Long-Term Volcano Monitoring, Lab Environment

INTRODUCTION

Embedded System

The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processors. For example, air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites (each radar probably includes one or more embedded systems of its own).Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economics of scale.

Physically embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure. Transportation systems from flight to automobiles increasingly use embedded systems. New airplanes contain advanced avionics such as inertial guidance systems and GPS receivers that also have considerable safety requirements.

Various electric motors

- Brushless DC motors.
- Induction motors.

DC motors, are using electric/electronic microcontrollers. Automobiles, electric vehicles, and hybrid vehicles are increasingly using embedded systems to maximize efficiency and reduce pollution. Other automotive safety systems include antilock braking systems (ABS), Electronic stability control (ESC/ESP), traction control (TCS) and automatic four wheel-drive.

LITERATURE SURVEY

A Tropical Volcano, High Predation Pressure, and the Breeding Biology of Arctic Waterbirds" A Circumpolar Review of Breeding Failure in the Summer of 1992, Published by Barbara Ganter and Hugh Boyd Arctic *Vol. 53, No. 3 (Sep., 2000), pp. 289-305* *Arctic Institute of North America*

"Volcanic hazards and their mitigation *Geological Society" (1998), London, Engineering Geology Special Publications*, W.J McGuire *1998, 15:79-95,*

"Fidelity and Yield in a Volcano Monitoring Sensor Network" by Geoff WernerAllen, Konrad Lorincz, Jeff Johnson, Jonathan Lees, and Matt Welsh Division of Engineering and Applied Sciences, Harvard University.

PROJECT DESCRIPTION

System Analysis

Existing Systems and Drawbacks

Permanent conventional volcano monitoring stations typically send their data from a single sensor to an observatory via analog or digital telemetry. Due to this the amount of data transmitted is limited by bandwidth of the hardware, hardships of sitting telemetry links. As a result, many threatening and active volcano maintain networks of fewer than ten stations. Many environmental scientists frequently lack sufficient real time and high fidelity data for volcano analysis and eruption prediction. So it is highly difficult to give real time data to the environmental scientists by existing conventional volcano monitoring systems. An active volcano provides a challenging environment to examine and advance sensor network technology.

The crater is a three dimensional environment with very rugged terrain, with diverse seismic and geophysical signals from rock avalanches, landslides earth quakes and gas /stream emissions. Volcanic eruptions or explosions may even destroy the stations. The occasional eruptions, as well as the heavy rain, snow, ice, and wind weather conditions poses significant challenges on the network robustness and self organizing healing ability.

Various geophysical and geochemical sensors generate continuous high-fidelity data, and there is a compelling need for real-time raw data for volcano eruption prediction research. For such a high data rate application, a key challenge is how to collect high fidelity data subject to the limited bandwidth available to the sensor nodes .In addition to the limited physical bit rate of the radios used on those low power platforms; radio links may experience packet loss due to the congestion, interference and multipath effects. This project overcomes the above mentioned drawbacks with the help of wireless sensor networks.

PROPOSED METHODS AND ADVANTAGES

The proposed project includes design and deployment experiences of a sensor network for real time high-fidelity volcano monitoring. To achieve this goal, we designed a comprehensive system with a number of features, such as robust communication stacks, intelligent sensing components, hybrid time synchronization protocols and light-weight network management tools. These stations formed a multi hop network and immediately began delivering real time continuous seismic, infrasonic, lightning, and GPS raw data to the control center. Despite the harsh weather conditions (e.g., heavy rain, snow, icing and gusts)

The main contribution of this project is the design of a robust sensor network optimized for rapid deployment during periods of volcanic unrest and providing real-time long-term volcano monitoring. The presented evaluation results demonstrate that the network achieves a remarkable reliability despite harsh weather conditions. The data quality meets the demand of USGS scientists. The presented system has broader impacts beyond volcano monitoring. Many seismic exploration applications, such as oil field seismic explorations, have similar requirements: time-synchronized high-fidelity data acquisition with remote configurability.

MODULE DESCRIPTION

Temperature Sensors

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. For example, a mercury-in-glass thermometer converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube. A thermocouple converts temperature to an output voltage which can be read by a voltmeter. For accuracy, most sensors are calibrated against known standards.

Sensors are used in everyday objects such as touch-sensitive elevator buttons (tactile sensor) and lamps which dim or brighten by touching the base. There are also innumerable applications for sensors of which most people are never aware. Applications include cars, machines, aerospace, medicine, manufacturing and robotics.

A sensor is a device which receives and responds to a signal. A sensor's sensitivity indicates how much the sensor's output changes when the measured quantity changes. For instance, if the mercury in a thermometer moves 1 cm when the temperature changes by 1°C, the sensitivity is 1 cm/°C (it is basically the slope Dy/Dx assuming a linear characteristic). Sensors that measure very small changes must have very high sensitivities. Sensors also have an impact on what they measure; for instance, a room temperature thermometer inserted into a hot cup of liquid cools the liquid while the liquid heats the thermometer. Sensors need to be designed to have a small effect on what is measured; making the sensor smaller often improves this and may introduce other advantages. Technological progress allows more and more sensors to be manufactured on a microscopic scale as micro sensors using MEMS technology. In most cases, a micro sensor reaches a significantly higher speed and sensitivity compared with macroscopic approaches.

Network Topologies

- **Star Topology**

In the star topology, the communication is established between devices and a single central controller, called the PAN coordinator. The PAN coordinator may be mains powered while the devices will most likely be battery powered. Applications that benefit from this topology include home automation, personal computer (PC) peripherals, toys and games. After an FFD is activated for the first time, it may establish its own network and become the PAN coordinator.

Each start network chooses a PAN identifier, which is not currently used by any other network within the radio sphere of influence. This allows each star network to operate independently.

- **Peer-To-Peer Topology**

In peer-to-peer topology, there is also one PAN coordinator. In contrast to star topology, any device can communicate with any other device as long as they are in range of one another. A peer-to-peer .network can be ad hoc, self-organizing and self-healing. Applications such as industrial control and monitoring, wireless sensor networks, asset and inventory tracking would benefit from such a topology. It also allows multiple hops to route messages from any device to any other device in the network. It can provide reliability by multipath routing.

- **Cluster-Tree Topology**

Cluster-tree network is a special case of a peer-to-peer network in which most devices are FFDs and an RFD may connect to a cluster-tree network as a leave node at the end of a branch. Any of the FFD can act as a coordinator and provide synchronization services to other devices and coordinators. Only one of these coordinators however is the PAN coordinator. The PAN coordinator forms the first cluster by establishing itself as the cluster head (CLH) with a cluster identifier (CID) of zero, choosing an unused PAN identifier, and broadcasting beacon frames to neighboring devices.

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