Active Deer Warning

Roadside Detection and Active Warning to Reduce Deer-Vehicle Crashes
Deer-Vehicle Collisions

- Over one million DVCs/year nationally
- 200 Fatalities
- 29,000 people injured/year
- $1.2 billion in property damage accidents
- These figures continue to rise
Deer-Vehicle Collisions
Minnesota Experience

- 4,500 DVCs/year
- Between 4 - 11 fatalities/year
- 475 people injured/year
- MN: Insurance company estimates 35,000 DVCs/year
- Large increase in injuries to motorcyclists
Preventive Measures to Reduce DVCs
Background

Project Location –

• South of Marshall, MN, Near Camden State Park

• ~1 Mile along TH 23
Deer Characteristics

- Frequent movements across TH 23 during May and November
- May be more than 100 crossings per day
- More than 100 deer killed per year
Previous Attempts at Mitigation

- Active system installed in 2001
- Driver-focused warnings of deer presence
- No attempt to modify deer behavior
- Equipped ~1 mile stretch of road
- Used 11 detection zones and 11 signs in each direction
Previous System Characteristics

- Detection used IR LASER beam interruption
- Beacons were incandescent lamps with rotating reflectors
- Power supplied by rechargeable batteries
- Detector outputs hard wired to beacon relays
Issues With Previous System

- System did not include a recharging system for batteries
- High power consumption drained batteries in 3-4 days in peak seasons
- No mechanism for activating opposing-direction traffic.
Mn/DOT & SRF’s New Approach

• Began as a Mn/DOT Innovative Ideas proposal in 2004
• Focused on several aspects
  – Reduced power consumption
  – Sustained power supply
  – Two-direction notification
  – Flexible sign/detector relationships
  – Ease of installation and configuration
  – Low install and maintenance costs
Reduced Power Consumption

- Detectors have very low power draw (70mW)
Reduced Power Consumption

- Solution was to replace with LED beacons for ~85% reduction in power demand
Sustained Power Supply

- Multiple devices and remote location made AC power unattractive
- Low power demand from devices made solar power workable
- Each sign and detector location fitted with a one sq. ft. panel, battery and charge controller
Two Direction Notification

• Need to alert drivers in both directions of travel
• High cost made “pushing conduit” under pavement unattractive
• Needed a simple, low power, wireless solution
Flexible Sign/Detector Relationships

• Needed to activate any combination of signs based on a detection
• Needed to be able to change sign to detector associations
• Hard-wiring was complex and difficult to reconfigure
• Needed a software-based approach
Ease of Installation and Configuration

- A general, as opposed to site specific, solution was needed
- Complex wiring or physical construction was to be avoided
- Should avoid any roadside infrastructure needs (AC power, guardrail, telephone service, etc.)
- Physical components should be familiar to DOT maintenance personnel
Low Install and Maintenance Costs

- System should be self-contained
- Components should be “off-the-shelf”
- Components should be easily replaced if damaged or failed
- Maintenance of components should be minimized
The Solution
The Solution

- Low-cost mesh network (ZigBee) devices
- System uses Coronis Wavelog
- ~3 year lifespan on internal battery
- ~1000m LOS range
- Internal processing of detection data
- Sign can be activated by any one of 15 detectors
- Low cost, sealed design
System Schematic

- Simple Installation uses existing structures
- Low power devices powered by solar/battery system
- Mesh network eliminates need for cabling
- Low cost makes system suitable for large areas
Set-Up Software

- Runs on PocketPC for ease of use in field
- Allows for configuration of sign/detector relationships
- Has wireless diagnostic functions (RSSI)
Installation

- Installed April 2007
- Removed several existing signs
- Added flashers
- Added power and communications to detectors
Evaluation

- System Operational 4/26/07
- Ten (10) DVCs in first year of operation
- 57% reduction in DVCs
- This trend continues for 2008
• Solar Power Chosen for:
  – Ease of Installation
  – Low Costs
  – “Green” Renewable Energy
Power Design and Experience

- Solar Power Design Process
  - Determine “Average Worst Day” Insolation Factor
  - Determine Power Requirements for Devices
  - Size Battery System for Desired Run Time
  - Select Panels Based on Output
Power Design and Experience

Insolation Maps Give Available Power

PV Solar Radiation
(Flat Plate, Facing South, Latitude Tilt)

Minimum Daily Solar Radiation Per Month
NOVEMBER

South-Facing Vertical Flat Plate

Produced by the Electric & Hydrogen Technologies & Systems Center - May 2004

National Renewable Energy Laboratory Resource Assessment Program

Power Design and Experience

• Seven Months of Deployment Provided Valuable Insight:
  – Spring, Summer, Early Fall were reliable
  – Can Get Significant Numbers of Days Significantly Worse Than “Worst Average” (fog is a problem)
  – Power Draw Varied in Unexpected Ways
  – Battery Reserves Became Depleted
Several Strategies Used to Address Problems:
Adjust Detectors to Maintain Better Alignment and Keep Power Consumption Down
Increase Solar Panel Size on Detector Sites (10W to 20W)
Increase Battery Size (5 Ah to 7.5 Ah)
Power Design and Experience

Other Possibilities:

Wind

Commercial Power
Evaluation

- Next peak movement season is November
- System will be monitored for functionality and performance
- Will compare 2006 DVCs with 2007 and 2008
- If effective, system may be expanded to other locations