St. Paul Parks Recreational Trail Sensor System

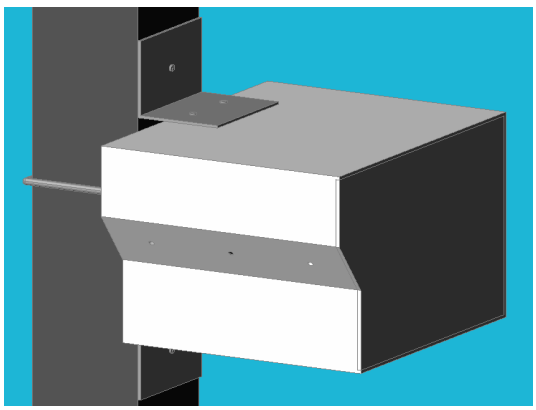
Sponsor: City of St. Paul Parks and Recreation Board
Sponsor's General Mission or Business Statement: Provide and facilitate safe, quality services, programs and facilities while preserving and enhancing natural resources and stimulating the economic vitality of the community.
Sponsor's Advisor, Title, and Phone Number: Eric Thompson, Director of Park Security, City of St. Paul, (651) 632-2415
Sponsor's Address: 1100 N. Hamline Avenue, St. Paul, MN 55108
Secondary Advisor: Scott Morgan of Stealth Technologies has provided funding, requirements and technical support to both the City of St. Paul and our team.
University of St. Thomas School of Engineering Academic Advisor: Dr. Christopher S. Greene
Team Member Names: Tiffany Craft (EE), Mike Moran (ME), Austin Nelson (EE), Zach Simmons (EE), Derek VanBeusekom (EE)
Senior Design Clinic I-II (ENGR 480-481) 2006-7 Mission Statement: Design a sensor system to monitor trail activity on park trails in the City of St. Paul by recording time, direction, speed, and activity of each pedestrian that passes by the system.

Major Design Requirements:

1. Count at least 85% of pedestrians within range of the system
2. Classify pedestrian activity as walking/jogging, rollerblading, biking, or other with 80% accuracy
3. Record pedestrian activity and speed to within ±2 MPH
4. Record time of activity
5. Record outdoor air temperature hourly within ±5 °F
6. All-weather operation during daylight hours
7. Tamper resistant

Senior Design Project Summary:

The project objective was to design a sensor system to monitor trail activity in the City of St. Paul to help the Parks and Recreation Board justify trail development decisions in St. Paul. The system records the speed, direction, and time that each pedestrian passes by the sensor system. In addition, the system identifies the pedestrian's activity as walking/jogging, rollerblading, or biking based off their speed, and makes hourly outdoor air temperature measurements. After researching various sensor options for solving similar problems, we decided to perform image processing using a pinhole camera to identify pedestrian activity. The user is required to set the date and time, replace batteries when necessary, and download the trail usage data as desired. All trail usage data is stored on an SD card and formatted to a text file that can be read by common software such as Microsoft Excel. Image processing code was developed to handle a wide variety of scenarios, including changes in global light levels, multiple people in the field of view at the same time, changes in shadowing, changes in weather conditions, and unexpected activities. The final product implements a simpler version of this code development for basic, reliable functionality, and is prepared to be upgraded in the future.



Sensor system casing and mounting scheme

Image processing example: grayscale, subtraction, threshold, and tracking