CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)

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Project Number

S1203

Project Title

Mathematical Algorithms for Sensor Footprint Employment: Year 2 of an Ongoing Study

Abstract

Objectives/Goals

In the previous year project, it was shown through a field experiment that a large number of detection zones can be created by overlapping a small number of sensor footprints. If the number of detection zones can be larger than the number of sensors, then there is a mathematical algorithm to calculate the maximum number of detection zones given a number of sensors. An experiment was conducted to formulate this algorithm.

Methods/Materials

The experiment was carried out by experimental graphing of sensor configurations with overlapping footprints. The numbers of detection zones produced for each configuration was manually counted and tabulated. A heuristic approach was taken to help discover a pattern for the series of tabulated numbers. Patterns included ones based on n, n^2, n^3, n^4... where n is the number of sensors.

Results

It was discovered that the n2 type pattern applied. A combinatorial relationship was found for the maximum number of detection zones given n sensors: $f(n)= n(n-1)+1$.

Conclusions/Discussion

The results obtained through this experiment support the hypothesis that an algorithm that calculates the maximum number of detection zones given any number of sensors could be created. This could in turn help to reduce the number of sensors needed to cover a plot of land with a maximum number of detection zones. This enables low-cost motion sensors to replace high-tech infrared tracking cameras. This is particularly economical in cases where the area to be covered becomes larger, such as in many homeland security applications.

Summary Statement

This project's algorithmic conclusion helps to maximize the number of detection zones created through overlapping motion sensor footprints, thus enabling motion sensors to replace high-cost security items such as infrared tracking cameras.

Help Received

Father helped with charting values; Dr. Andrew Ho at Harbor UCLA helped with algorithmic visualization