Robust earthquake detection using e-pucks

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***Abstract* — In this preliminary report we aim to present the current status of our research with earthquake detection via e-pucks as well as to present challenges, ideas, and the general directional bearing of our future research.**

I. Introduction & Motivation

E-pucks are miniature mobile robots developed for educational purposes. Our research is based on detection of the geographical epicenter of earthquake-like vibrations using a small horde of e-pucks. The double challenge of the software design and implementation on real robots of such a behavior attracted us. Applied to the physical reality of our world, the question of earthquake detection will be more than a software simulation. Problems like hardware differences, noises, time synchronization, communication delays will have to be solved.

II. Work Accomplished / Design Decisions

A. Obtained A Clear Understanding of the Problem

By meeting amongst ourselves and verifying our conception of the project with our project supervisor , we have solidified a clear picture of the specific problem we are trying to solve. Below are some of the ideas, concerns, and difficulties involved in our research.

1) Position of the robots

The e-puck is a small-differential drive robot. The robot can be moving when the vibration occurs. The robot should know his relative position to the other robots in order to compute the provenance of the earthquake. Should we be assuming the robots to be mobile or fixed-position?

2) Timing Concerns and Communication Between Robots

Another design concern involves the method by which our e-pucks will interact in order to collectively determine the vibration epicenter. A high-level communication protocol should allow the robot to share their information about the vibration they detect and report their relative position in the euclidean space. A leader could centralize the information or each robot could decide according to the information it received from the group. Should these robots be making shared or centralized decisions?

3) Off-line or On-line processing

We can push the job of computation of the geographical location of the vibration to each robot or we can have the robots transmit their findings to a central processing unit responsible for the computation. Given the computational constraints of the e-puck, should we be processing the data offline or online?

4) Solving For Variable or fixed number of robots

The number of robots responsible for the determining the epicenter can affect the accuracy of our localization. As soon as additional robots are added or move into the neighborhood of the vibration, we could use the new information to increase the accuracy of our findings. Shall we consider a fixed number or variable number of robots?

B.Our approach / Upcoming Work

During the first weeks of our research, we tried to circle the question, understand the constraints, and define various milestones to help aid the research. We will be using three e-pucks at pre-determined static locations who will collectively report accelerometer values when they detect a meaningful shock. These reports will then be processed at the level of the e-puck or at a centralized level in order to triangulate and determine the epicenter. Moreover, we have downloaded and began to read research papers in this domain, in order to see what has been done and how they have dealt with the difficulties involved in such a project.

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