Simulating Swarm Behavior with Robotics

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Project #: 099

Introduction

Animal swarm behavior is complex, chaotic, and often unpredictable. This project aims to gain insight into swarms by use of robots known as Kilobots. Designed in 2010 at Harvard, these tiny bots can be programmed individually or be given commands by the overhead command to act collectively.

Since their inception in 2010, Kilobot's have seen a fall off in popularity and are no longer widely used. This means that the software and tools necessary for them to run are outdated and hard to find. The beginning phase of this research is to find ways to get them up and running again, so hopefully they can be revitalized and be used in further swarm research.

Future Research

Due to the age of the Kilogui software and the allusivity of packages for programming the bots, we believe it is best to remake the software.

This would be done using Java and VSCode to make a modern cross-platform GUI which can send instructions to the overhead controller.

To gain insight on how to program the bots, a serial port sniffer could be used to see what Kilogui is sending to the controller through the serial port. Our new GUI could then replicate these packets, allowing the bots to be programmed just the same.

Making our own software would fix problems of platform compatibility and allow others across the world to program Kilobots with modern software.

Once we have a modern way to work with the bots, we can program them to their fullest potential. Kilobots have self healing capability– reassembling a predefined configuration if damaged– and light sensors to react to the ambience of the environment. Having access to these capabilities would allow to do more extensive research on swarms in nature.

Results

We ran the Kilogui software on Debian using Qt4. This provides us with the interface to give commands to the overhead command and then send them to the Kilobots. We do not have the capability to program the Kilobots ourselves yet, but they come preprogrammed with demo code. We can run the demo code and observe a few behaviors.

Observed behaviors from Kilobot demo code:

1. Kilobots move randomly, but independently.
2. The LED on each Kilobot changes on fixed but independent intervals, which changes their speed.
3. When one or more Kilobot's get close together or "herd" , they stop moving.

The Kilobot's are also sensitive to the material in which they are moving on. Small indents on wooden tables or particles on the floor can disrupt their movement. They use three prongs which are vibrated by two motors to move around. Because of this, we opted to run them on a horizontal dry erase board. This provides a smooth surface with large enough area to see their behavior.

Materials and methods

We ran the old Kilogui software (figure 1) on Debian.

The Kilobot kit comes with the overhead controller (figure 2), debug cable, charging rods, and Kilobots (figure 3). A white board is used to give the bots a surface to run on.

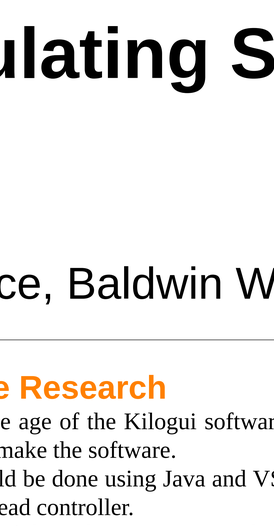

Figure 1: Shown is the Kilogui software Which grants control of the Kilobot's via the Overhead controller.

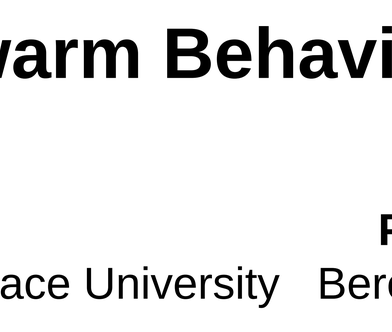

Figure 2: Shows the overhead control Used to send messages to the Kilobots

Figure 3: Shows the Kilobot with the charging hook attached

Literature cited

Tahabilder, Anik. "BUILDING KILOBOTS AND REVISING KILOBOT DESIGN FOR IMPROVING THE OPTICAL RESPONSE." *Graduate School of Western Carolina University*, 2020

For further information

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