**INTRODUCTION**
This project aims at increasing the overall efficiency of obstacle avoidance for our corobots. Corobots use the well-known potential field algorithm for avoiding obstacles which isn’t without its limitations. During our analysis, the biggest limitation we found was the corobot would get stuck at local minima’s preventing it from going through tight spaces such as doors. This project aims at removing this limitation without causing any additional problems by using a modified potential field algorithm heavily based off of [1, 2].

**BACKGROUND**
Corobots are inexpensive $1000 autonomous robots with the following components:
- Roomba (movement)
- Netbook (control and interactivity)
- Microsoft Kinect (depth sensing)
- Webcams (QR-code landmark localization)

Increasing the success of the corobot’s ability to avoid obstacles will have a significant impact on the ability to deploy these corobots completely. Several goals we have for these corobots include:
- Integrate into CS curriculum
- Delegate tasks for human needs
- Upload code to web server for remote control

**TRADITIONAL APF**

\[ F_{net} = F_{att} + \sum_{o \in \text{obs.}} F_{rep}(o_i) \]

Traditional artificial potential fields are prone to deadlocks when there is not enough force to get through narrow passageways or an obstacle is collinear to the goal.

**MODIFIED APF**

\[ F_{net} = F_{att} + \sum_{o \in \text{obs.}} (F_{rep}(o_i) + F_{perp}(o_i)) \]

Adding an extra force that is perpendicular to the \( F_{rep} \) elegantly reduces deadlocks. We examined various magnitudes of this new force including:
- \( \min(0.4, F_{rep}) \)
- \( 20/(1 - e^{\pi}) \)
- \( 30/(1 - e^{\pi}) \)

**RESULTS**
We created a four environment benchmark with both static and dynamic obstacles to encapsulate common scenarios the corobot might encounter if it were fully deployed. Each of the following barcharts represent a different metric we used to compare the original baseline APF with our three modified APF’s.

**DISCUSSION**
We have successfully improved the corobot’s obstacle avoidance by enabling it to navigate through narrower passages without compromising any other environments. With a few exceptions, the summarized results for all three \( F_{perp} \) magnitudes tested include:
- ability to navigate narrow passageways
- fewer collisions
- fewer robot assists needed
- slightly quicker travel times
- slightly shorter travel distances

**FUTURE WORK**
We found localization problems occurring more frequently than desired during our benchmarking which accounted for numerous failures to reach the destination. Consequently, we believe future corobot work should focus on more accurate estimations of its current location.

**REFERENCES**