

## Background and Objective

How can artificial intelligence and robotics come together to create a robot that has the ability to find, track, and fill cracks in concrete? This is the driving question for this project; we know over the life span of concrete structures, cracks begin to form. These cracks cause safety issues and decline the structural health. Our goal is to create a robot that utilizes artificial intelligence to autonomously fill cracks.



Figure 1. Crack filler in use



Figure 2. Robot Tank Base

## Requirements

The Robot must:

- Autonomously detect cracks
- Follow a uniform linear crack
- Autonomously fill surface cracks
- Use artificial intelligence elements

## Progress

**The team has:**

- Chosen robotic base (Figure 2.)
  - ◆ Parts must be able to be mounted easily to the base
  - ◆ The components must be customizable and adaptable to the robot base
- Chosen sensors; Lidar and Depth Sensor Cameras (Table 1.)
  - ◆ Sensors must be able to detect depth of a crack (Figure 3) is an example of how the cameras process images
  - ◆ The sensors must be able to provide a point of reference for the robot's position relative to the starting position
- Created 3D printed models to mount parts
  - ◆ Part mounts must be lightweight to accommodate the load capacity
  - ◆ Part mounts must be compatible with the dimensions of the robot frame, and must be easily mountable

Table 1 : QFD Chart for the Sensors

Sensor QFD: 5 is the best score	Depth Camera	Lidar Camera
Infrared Projector	5	1
Lidar	1	5
Accuracy	4	5
Ambient Light	3	5
Minimum Range	3	5
Cost	5	4
<b>Total</b>	<b>21</b>	<b>25</b>

**Data Fusion:**

- The combination of data from the two sensors
- Use of data fusion allows the robot to have a complete map of the area
- Overlapping data points can be fused together using a weighted average of the two points' values for the depth
- AI will control the robots movement and also the filler system to fill cracks
- This will be done by searching for depths below the mean of the concrete slab

**Filler system:**

- The final filler system mount (Figure 4.) has been designed
- With the final mount we moved the holding tank to the top of the base
- The mount is placed on the front of the robot to allow more precise crack filling
- Will use the sensors and data fusion to provide guidance for the robot will performing its tasks

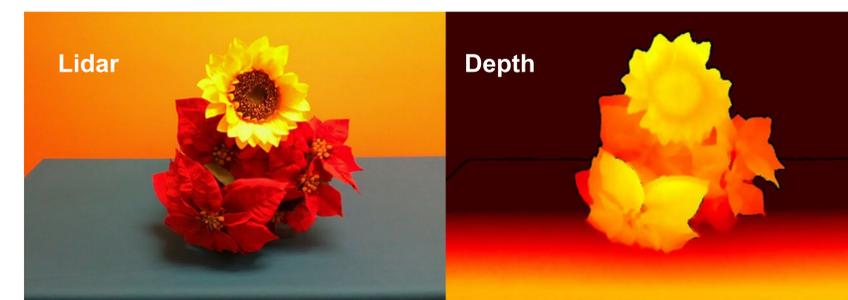


Figure 3. Comparison of the Lidar camera vs Depth Sensor

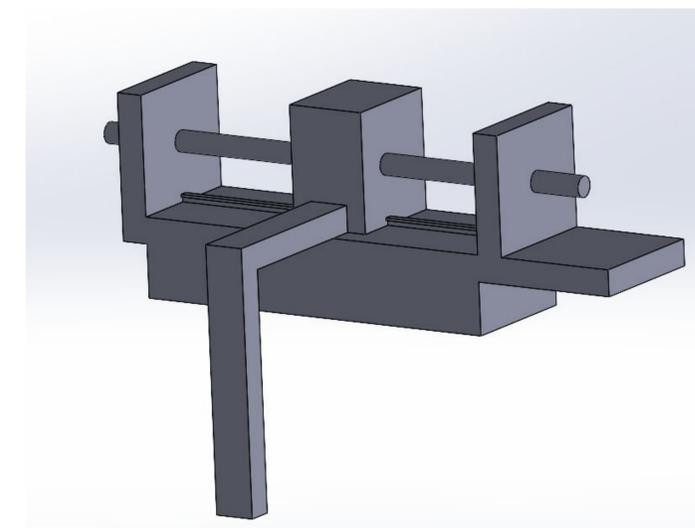


Figure 4. Filler Mount System

## Future Work

Upcoming semester these tasks will be completed:

- Capable of following nonuniform nonlinear cracks
- Estimate volume of cracks and dispense a proper amount of filler material
- Run off an entire portable power supply
- Continue working on the artificial intelligence aspects and increase efficiency