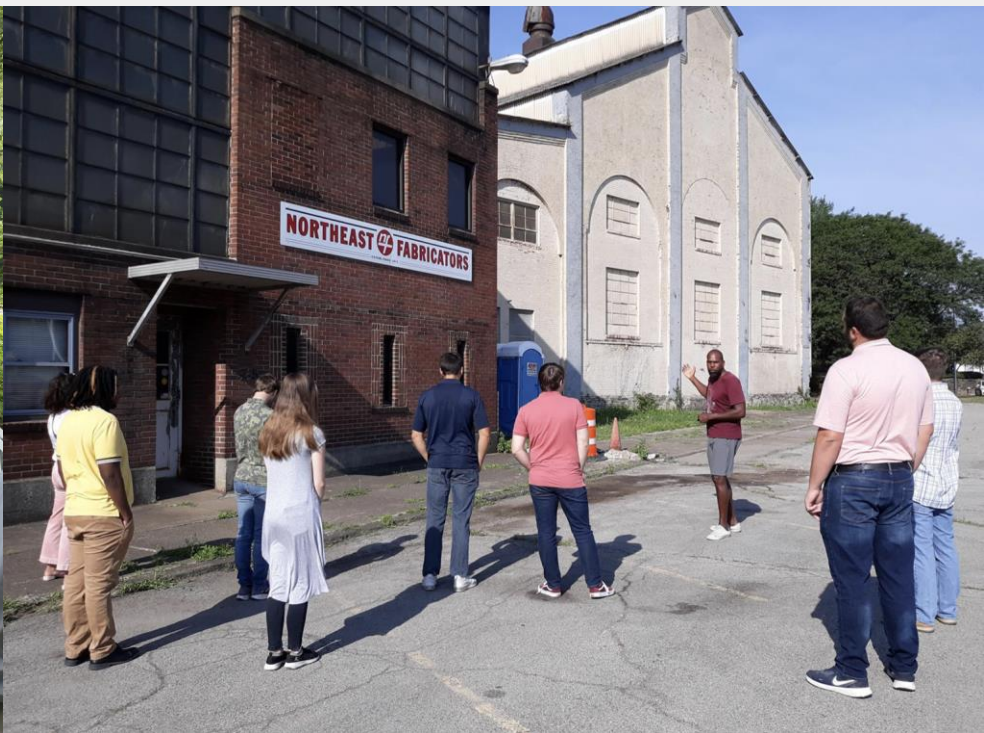# Welcome!

2022 YSU/EAG Internship Program Final Reports

Thank You!

- Youngstown State University
- YSU Department of Engineering
- Excellence Training Center at Kohli Hall
- University of Notre Dame
- Mill Creek MetroParks
- Youngstown Historical Center for Industry and Labor
- Economic Action Group
- City of Youngstown
- Youngstown Neighborhood Development Corporation
- Youngstown Business Incubator
- Voyager Coffee & Tea
- Youngstown Flea

Internship Presentations

The Mechanics

Colin McDonald
Mechanical Engineering

David Schmidt
Mechanical Engineering

Adrian Jones
Mechanical Engineering

Neighborhood Development

economic **ACTION** group inc.

Y YOUNGSTOWN STATE UNIVERSITY

By: The Mechanics

David Schmidt, Colin McDonald, Adrian Jones

Sponsors: Economic Action Group and Youngstown State University

Academic Advisor: Dr. Hazel Marie

Industrial Advisor: Mike Durkin, Code Enforcement Superintendent of Youngstown

EAG Advisors: Nick Chretien, Executive Director of EAG; Daniel Bancroft, Program Manager at EAG; Gianna Marinucci, Program Manager at EAG

Neighborhood Planning and Demolition

economic ACTION group inc.

YOUNGSTOWN STATE UNIVERSITY
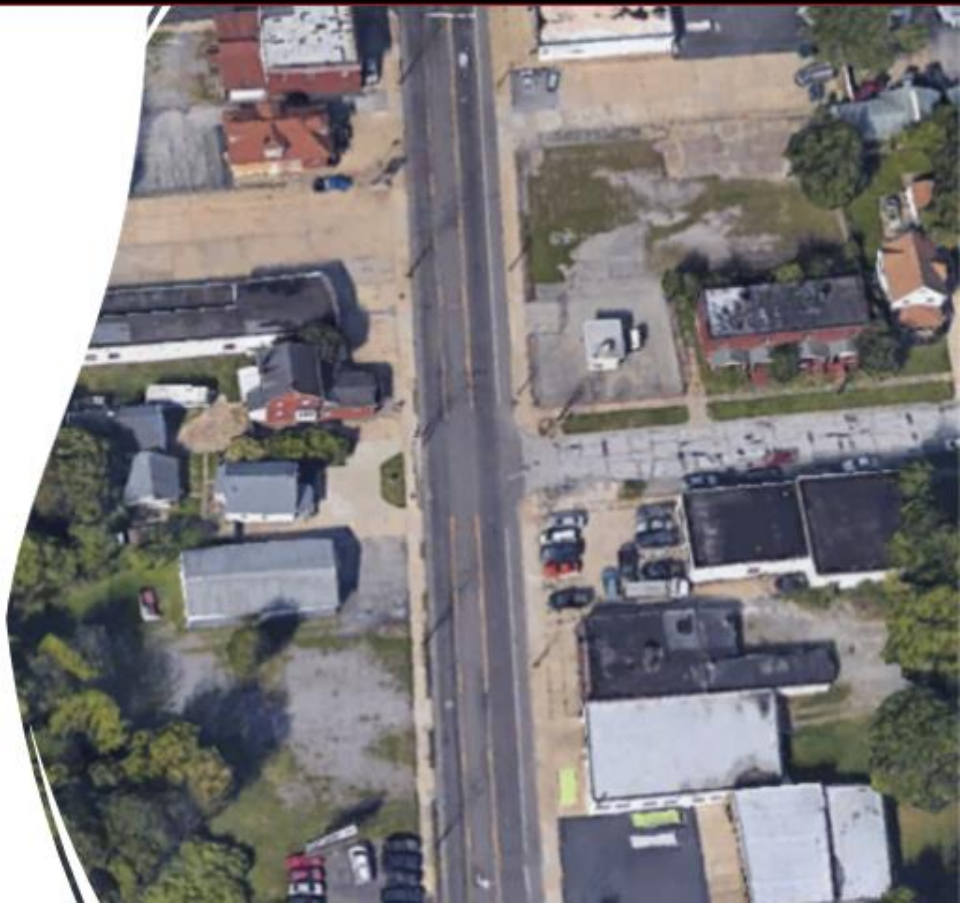
Contact: Mike Durkin, Code Enforcement Superintendent of Youngstown

Problem/Challenges:

- After seeing a mass exodus of residents after the 1977 collapse of the steel industry and once a home of 170,000 residents – Youngstown now has to 'right-size' its housing supply after years of vacancy and abandonment.
  - There are 836 homes that would qualify for demolition in the City.
  - Many commercial corridors remain littered with vacant buildings and parking lots left over from torn down buildings.

Project Description:

- Students would work on specific neighborhoods or corridors for development. This could tie in creating demolition algorithms in target areas, which could also be used citywide. 3D modeling of existing structures and opportunity areas would be a great addition.

Project Statement & Sponsor

- Worked with the City of Youngstown and EAG to create a MATLAB algorithm
- Developed algorithm based on the building's characteristics and maintenance code violations
- Algorithm used to suggest demolition or renovation of a property
- Algorithm also used to compile violation of city codes
- Focused on one node along Mahoning Avenue to showcase use of the MATLAB algorithm.

Project Team Definition

Project Roles:

David Schmidt: Research, MATLAB algorithm

Colin McDonald: Research, 2-D & 3-D models, Gantt Chart

Adrian Jones: Research, MATLAB algorithm

Resources:

Code enforcement and zoning maps from Mike Durkin

Youngstown RPIS from John Bralich
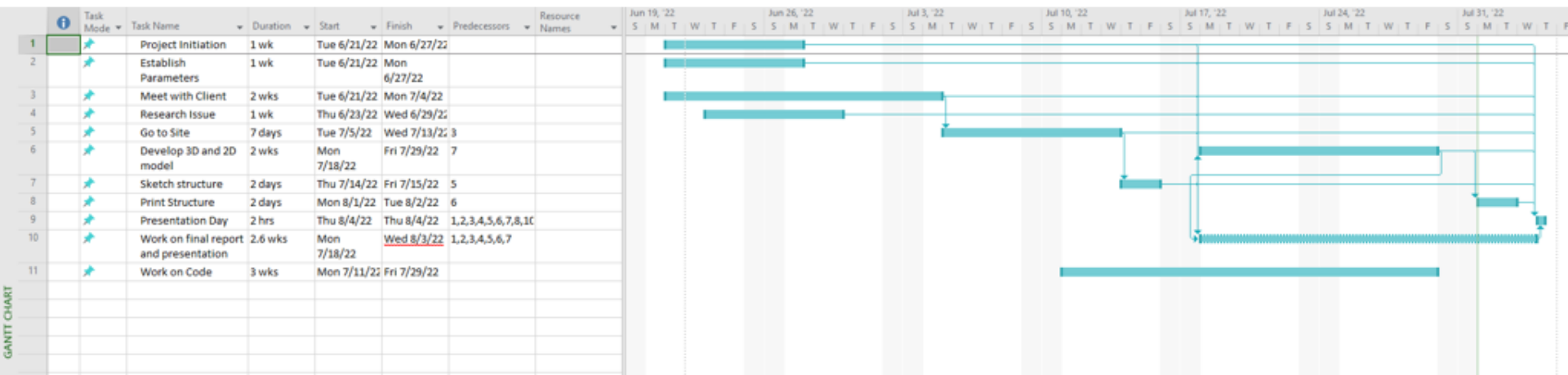
Mahoning County Auditor website

Zoning books from the City of Youngstown

A market analysis of: Commercial corridors in Youngstown, Ohio by Novogradac Consulting LLP.

YNDC's Upper West Side Neighborhood Plan

Independent project surveying conducted by project team

Gantt Chart

|	ⓘ	Task Mode ▾	Task Name ▾	Duration ▾	Start ▾	Finish ▾	Predecessors ▾	Resource Names ▾
1		📌	Project Initiation	1 wk	Tue 6/21/22	Mon 6/27/22		
2		📌	Establish Parameters	1 wk	Tue 6/21/22	Mon 6/27/22		
3		📌	Meet with Client	2 wks	Tue 6/21/22	Mon 7/4/22		
4		📌	Research Issue	1 wk	Thu 6/23/22	Wed 6/29/22		
5		📌	Go to Site	7 days	Tue 7/5/22	Wed 7/13/22	3	
6		📌	Develop 3D and 2D model	2 wks	Mon 7/18/22	Fri 7/29/22	7	
7		📌	Sketch structure	2 days	Thu 7/14/22	Fri 7/15/22	5	
8		📌	Print Structure	2 days	Mon 8/1/22	Tue 8/2/22	6	
9		📌	Presentation Day	2 hrs	Thu 8/4/22	Thu 8/4/22	1,2,3,4,5,6,7,8,10	
10		📌	Work on final report and presentation	2.6 wks	Mon 7/18/22	Wed 8/3/22	1,2,3,4,5,6,7	
11		📌	Work on Code	3 wks	Mon 7/11/22	Fri 7/29/22		

5

Mahoning Avenue

- Mahoning Avenue between Hazelwood and Hartford chosen
- Most building/properties appear to be vacant
- Originally same type of businesses and not enough variations
- Large potential for economic development
- Mahoning Avenue heads straight to downtown
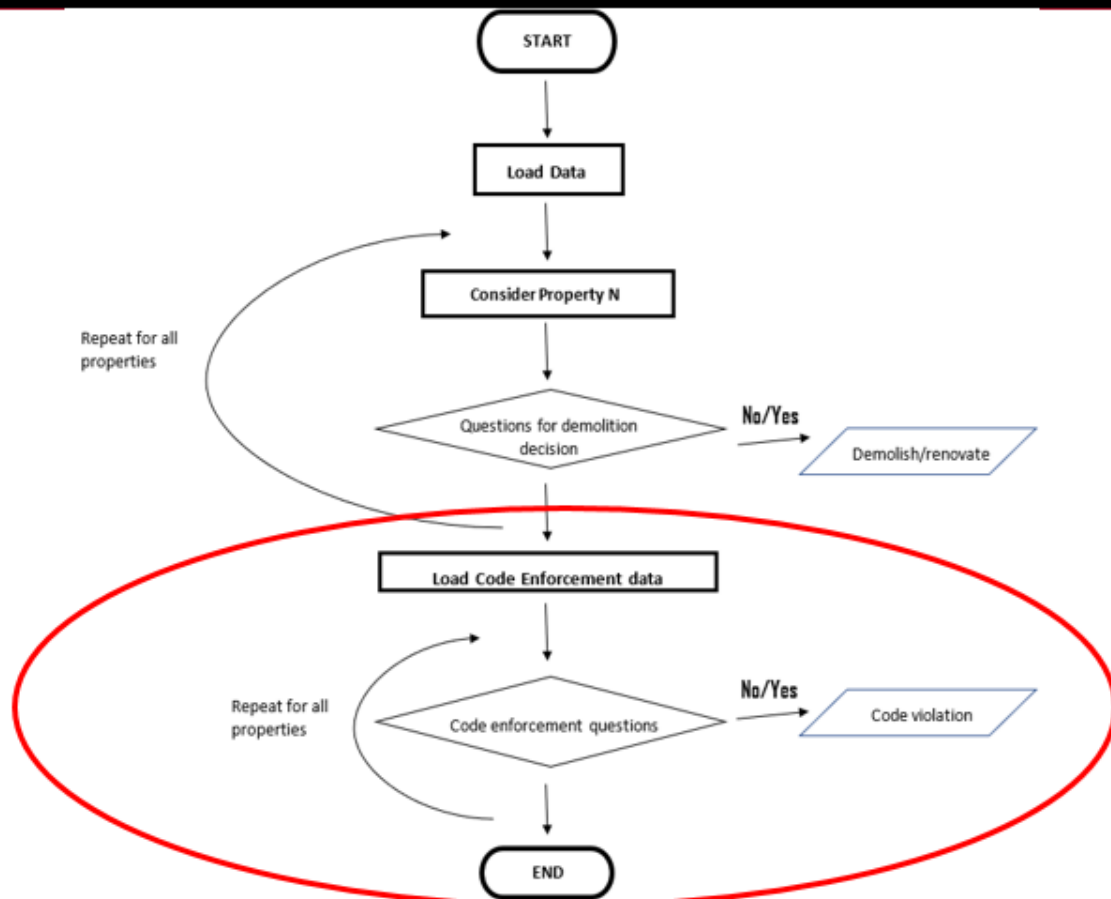
RPIS Map View
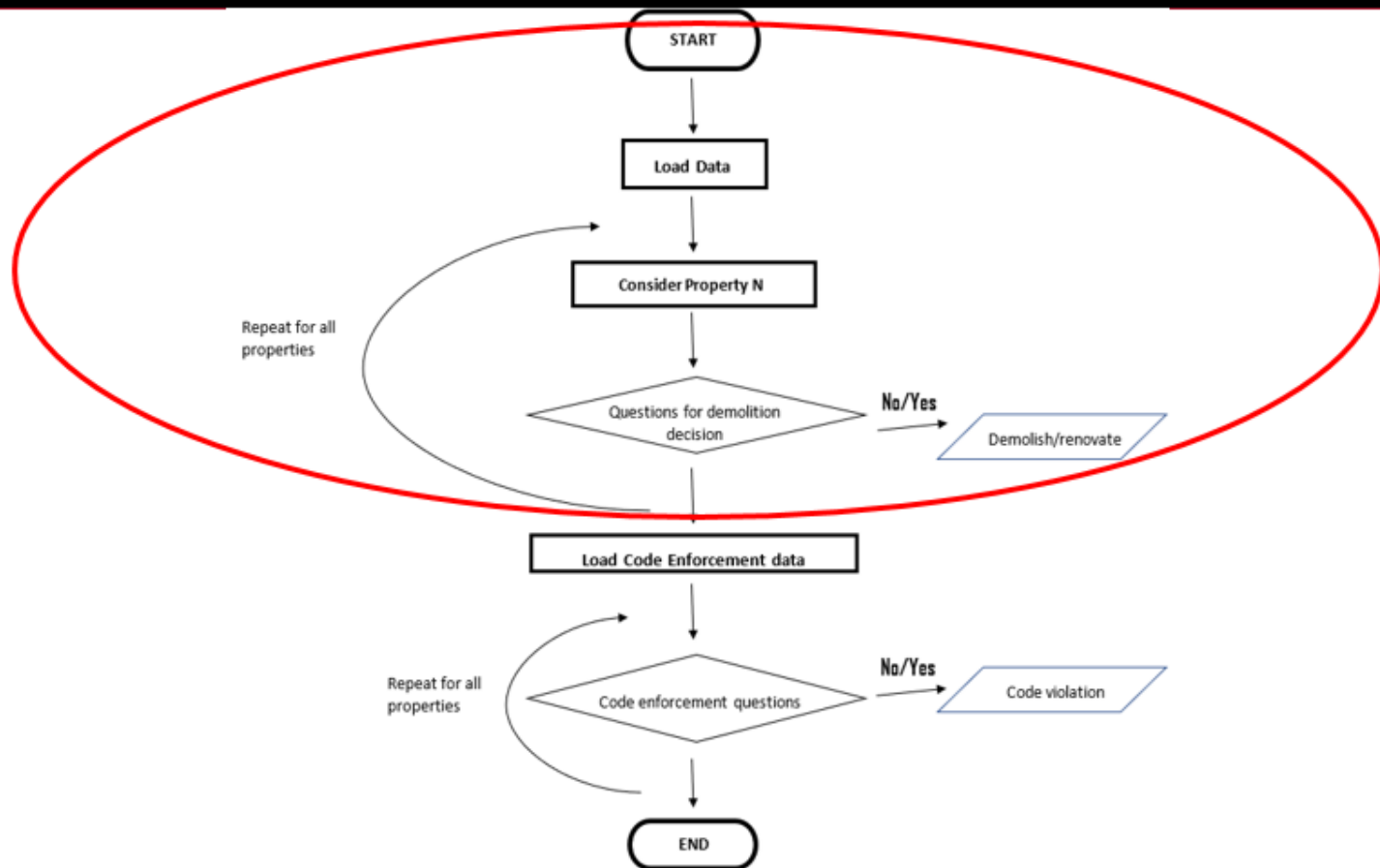
Algorithm Summary

Demolition Algorithm/Code

- Is the structure safe?
- Are there collapsing components?
- Is the roof deteriorated?
- Is the building a historical building?
- Is the foundation deteriorating?
- Does the property violate more than 35% of the code enforcement list? Is the structure in a habitable condition?

- Based on questions, with answer range 1-5
- N/A questions depending on property type were given a '0'
- Answers were loaded into the code with specific combinations of answers, leading to a suggestion of demolish, renovate, or greenspace.

Demolition Algorithm/Code

	Is the structure safe?	Are there collapsing components?	Is the roof deteriorated?	Is the building a historical building?	Is the foundation deteriorating?	Was the building built incorrectly (unlevel foundation, not enough support beams, improper electrical circuitry)	Is there tax delinquency?	Does the property violate more than 35% of the code enforcement list?	Is the structure in a habitable condition?
2502 Mahoning ave.	5	1	4	1	1	1	1	2	2
4 Manchester Ave.	0	0	0	0	0	0	1	0	3
2 Manchester Ave.	0	0	0	0	0	0	1	0	3
8 Manchester Ave.	0	0	0	0	0	0	1	0	3
2512 Mahoning Ave.	0	0	0	0	0	0	1	0	0
2528 Mahoning Ave.	5	1	1	1	1	1	1	2	1
2521 Mahoning Ave.	5	1	1	1	3	3	1	2	1
2606 Mahoning Ave.	5	1	1	1	3		1	2	1
2600 Mahoning Ave.	3	1	1	1	1		1	2	1
2509 Mahoning Ave.	3	2	2	1	3		1	2	3
2432 Mahoning Ave.	2	4	3	1	3		5	2	1
2422 Mahoning Ave.	5	1	1	1	1		4	2	1
2420 Mahoning Ave.	5	1	1	1	1		1	2	1
2402 Mahoning Ave.	5	1	1	1	2		1	2	1
2503 Mahoning Ave.	5	1	1	1	2		1	2	1
2429 Mahoning Ave.	5	1	1	1	1		1	2	1
6 Manchester Ave.	0	0	0	0	0	0	1	2	0
2433 Mahoning Ave.	5	1	1	1	1		1	2	1
2423 Mahoning Ave.	0	0	0	0	0	0	0	0	0
2419 Mahoning Ave.	0	0	0	0	0	0	0	0	0
2403 Mahoning Ave.	5	1	3	1	4		1	2	1
2408 Mahoning Ave.	5	1	1	1	1		1	2	1

Algorithm Summary

START

Load Data

Consider Property N

Repeat for all properties

Questions for demolition decision — No/Yes → Demolish/renovate

Load Code Enforcement data

Repeat for all properties

Code enforcement questions — No/Yes → Code violation

END

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Code Enforcement Criteria

- For code enforcement: 1 is no violation; 0 is violation present
- Some are put into one scenario and others stand by themselves

Examples:

- Sanitation
- Grading and Drainage
- Sidewalks & Driveways in Good Condition
- Rodent Harborage
- Defacement of Property Disposal of Rubbish/Garbage
- Structural Members in Good Condition
- Exterior Walls in Good Condition, Free of Cracks
- Motor vehicles
- Weeds

Code Enforcement

	Sanitation	Grading and Drainage	Sidewalks & Driveways in Good Condition	weeds	rodent Harborage	Exhaust Vents: Must not produce any visible gas or odor directly into populated areas	Accessory Structures (detached fences, walls, garages): structurally sound and in good shape	Deface
2502 Mahoning ave.	1	0	0	0	1		0	
4 Manchester Ave.	1	1	1	1	1	1	1	
2 Manchester Ave.	1	1	1	1	1	1	1	
8 Manchester Ave.	1	1	1	1	1	1	1	
2512 Mahoning Ave.	1	1	1	1	1	1	0	
2528 Mahoning Ave.	1	1	1	1	1	1	1	
2521 Mahoning Ave.	0	0	1	0	0	1	1	
2606 Mahoning Ave.	1	1	1	1	0	1	1	
2600 Mahoning Ave.	1	1	1	0	1	1	1	
2509 Mahoning Ave.	1	1	1	1	1	1	1	
2432 Mahoning Ave.	0	1	0	0	1	1	1	
2422 Mahoning Ave.	1	1	1	1	1	1	1	
2420 Mahoning Ave.	1	1	1	1	1	1	1	
2402 Mahoning Ave.	1	1	0	0	1	1	1	
2503 Mahoning Ave.	1	1	1	0	1	1	1	
2429 Mahoning Ave.	1	1	1	1	1	1	1	
6 Manchester Ave.	1	1	1	1	1	1	1	
2433 Mahoning Ave.	0	1	0	0	0	1	1	
2423 Mahoning Ave.	1	1	1	1	1	1	1	
2419 Mahoning Ave.	1	1	1	1	1	1	1	
2403 Mahoning Ave.	0	1	0	0	1	1	1	
2408 Mahoning Ave.	1	1	1	0	1	1	1	

MATLAB Algorithm

```matlab
1   clc
2   clear all
3   close all
4   load final_product.mat
5
6   %N represents the number of properies accounted for.
7   N = input('Enter the number of properties: ');
8   disp(" ")
9
10  for i=1:N
11
12  % This if statement is whether the structure is safe or not.
13      if dr3(i, 1) <= 2 && dr3(i,1)~=0
14          status(i) = "    -Consider emergency demolition:";
15
16  % For vacant properties.
17      elseif dr3(i,1)==0
18          status(i) = "    -Consider renovation:";
19
20  % Collapsing components and deterioration of foundation.
21      elseif dr3(i,2) + dr3(i,5) >= 8 && dr3(i,2)~=0
22       status(i) = "    -Consider demolition:";
23
24  % From sheet 2, if the property is misused.
25      elseif drS1(i,11) >3
26          status(i) = "    -Consider moving business to a more suitable location:";
27
28  % Deteriorating roof and foundation.
29      elseif dr3(i,3) + dr3(i,5) >= 8
30          status(i) = "    -Consider demolition:";
```

```matlab
32  % For historical building.
33      elseif dr3(i,4) <= 4
34          status(i) = "    -Consider renovation:";
35
36  % Was the building built wrong. I.e., (unlevel foundation, not enough support beams, improper electrical circuitry, etc.
37      elseif dr3(i, 6) >= 3 && dr3(i, 6) ~= 0
38          status(i) = "    -Consider renovation:";
39
40  % Does the property have tax delinquency and code violations.
41      elseif dr3(i,7) + dr3(i,8) >2
42          status(i) = "    -Consider renovation:";
43
44  % The bulding is in habitable condition.
45      elseif dr3(i,9) >= 3
46          status(i) = "    -Consider renovation:";
47
48  % If the building is abandonded/vacant.
49      elseif drS1(i, 2) + drS1(i, 7) >= 8
50          status(i) = "    -Consider renovation:";
51
52  % Trash and dumping.
53      elseif drS1(i,1) + drS1(i,5) <= 4
54          status(i) = "    -Consider renovation:";
55
56  % Condition of the building.
57      elseif drS1(i,3) + drS1(i,4) + drS1(i,6) >= 9
58          status(i) = "    -Consider renovation:";
59
```

MATLAB Algorithm

final_script.m

```matlab
60        % Runoff potential.
61            elseif drS1(i,9) < 3
62                status(i) = "   -Consider renovation:";
63
64        % Asphalt or pavement lot.
65            elseif drS1(i,8) < 3
66                status(i) = "   -Consider pavement removal:";
67
68        % If not met by criterion, renovation.
69            else
70                status(i) = "   -Consider renovation:";
71
72            end
73
74        % Green space.
75            if drS1(i,10) >= 3
76                status(i) = "   -Consider keeping it as a Green Space or build communal area:";
77            end
78        end
```

```matlab
80        % Code enforcement from sidewalk view
81        add(1)= "For 2502 Mahoning Ave:";
82        add(2)= "For 4 Manchester Ave:";
83        add(3)= "For 2 Manchester Ave:";
84        add(4)="For 8 Manchester Ave:";
85        add(5)= "For 2512 Mahoning Ave:";
86        add(6)= "For 2528 Mahoning Ave:";
87        add(7)= "For 2521 Mahoning Ave:";
88        add(8)= "For 2606 Mahoning Ave:";
89        add(9)= "For 2600 Mahoning Ave:";
90        add(10)= "For 2509 Mahoning Ave:";
91        add(11)= "For 2432 Mahoning Ave:";
92        add(12)= "For 2422 Mahoning Ave:";
93        add(13)= "For 2420 Mahoning Ave:";
94        add(14)= "For 2402 Mahoning Ave:";
95        add(15)= "For 2503 Mahoning Ave:";
96        add(16)= "For 2429 Mahoning Ave:";
97        add(17)= "For 6 Manchester Ave:";
98        add(18)= "For 2433 Mahoning Ave:";
99        add(19)= "For 2423 Mahoning Ave:";
100       add(20)= "For 2419 Mahoning Ave:";
101       add(21)= "For 2403 Mahoning Ave:";
102       add(22)= "For 2408 Mahoning Ave:";
103
104
105
```

MATLAB Algorithm


```matlab
105
106    for i=1:N
107       % Sanitation.
108       if CodeEnforcement(i,1) == 0
109           n1(i) = "      -Investigate possible sanitation issues";
110       else
111           n1(i) = "      -No sanitation issues appear";
112       end
113
114
115    % Rodent Harborage.
116       if CodeEnforcement(i,5) == 0
117           n5(i) = "      -Get rid of rodents before demolishing or renovating";
118       else
119           n5(i)= "      -No rodent problems exist";
120       end
121
122    %    Driveway and Sidewalk Conditions.
123       if CodeEnforcement(i,3) == 0
124           n3(i) = "      -Driveway or sidewalk are in poor condition";
125       else
126           n3(i)= "      -No repairs for driveway or sidewalk needed";
127       end
128
129       % Detached fences, walls, garages.
130       if CodeEnforcement(i,7) == 0
131           n7(i) = "      -Detached fences, walls, or garages in poor condition";
132       else
133           n7(i)= "      -No repair for walls, fences, or garages needed";
134       end
```

```matlab
143    % Exterior wall.
144    if CodeEnforcement(i,11) == 0
145        n11(i) ="      -Exterior wall on building in poor condition";
146    else
147        n11(i)="      -Exterior Wall on building is intact";
148    end
149
150
151     % exterior installment enforcement.
152    if CodeEnforcement(i,12) + CodeEnforcement(i,13) + CodeEnforcement(i,14) + CodeEnforcement(i,15) + CodeEnforcement(i,16) + CodeEnforcement(i,17) <= 5
153        n12(i) = "      -Decorative features, overhang extensions, stairways/decks/porches/balcony, railings, chimneys and towers, or glazing in poor condition";
154    else
155        n12(i)="      -No repair needed for decorative features, overhang extensions, stairways/decks/porches/balcony, railings, chimneys and towers, or glazing";
156    end
157
158
159    % Exhaust vents producing visible gas and odor present.
160    if CodeEnforcement(i,6) + CodeEnforcement(i,9) < 2
161        n6(i) = "      -Exhaust vents producing visible gas or an odor is present";
162    else
163        n6(i) = "      -No visible gas nor odor present from exhaust vents";
164    end
165
166    % Motor Vehicles violation
167    if CodeEnforcement(i, 18) == 0
168        n18(i) = "      -Inoperable motor vehicles present";
169    else
170        n18(i) = "      -No inoperable vehicles present";
171    end
```

MATLAB Algorithm

```matlab
172
173             % Weed/vegitaion violation
174             if CodeEnforcement(i,19) == 0
175                 n19(i) = "        -Weeds exceed the eight-inch height limit";
176             else
177                 n19(i) = "        -No weed violations appear";
178             end
179
180     end
181
182     for i = 1:N
183         disp(add(i))
184         disp(status(i))
185         disp(n1(i))
186         disp(n5(i))
187         disp(n3(i))
188         disp(n6(i))
189         disp(n7(i))
190         disp(n8(i))
191         disp(n11(i))
192         disp(n12(i))
193         disp(n18(i))
194         disp(n19(i))
195         disp(" ")
196
197     end
198
199
200
201
```

final_script.m

Algorithm Output

For 2502 Mahoning Ave:

-Consider moving business to a more suitable location:

-No sanitation issues appear

-Driveway or sidewalk are in poor condition

-Detached fences, walls, or garages in poor condition

-Structural members are defaced/need repairing

-Exterior wall on building in poor condition

-Weeds exceed the eight-inch height limit

18

Algorithm Output

For 4 Manchester Ave:

-Consider keeping it as a Green Space or build communal area:

-No sanitation issues appear

-No repairs for driveway or sidewalk needed

-No repair for walls, fences, or garages needed

-No inoperable vehicles present

-No weed violations appear

Algorithm Output

For 2432 Mahoning Ave:

-Consider emergency demolition:

-Investigate possible sanitation issues

-Driveway or sidewalk are in poor condition

-Exterior wall on building in poor condition

-Weeds exceed the eight-inch height limit

3D Model

Manchester Ave.

Mahoning Ave.
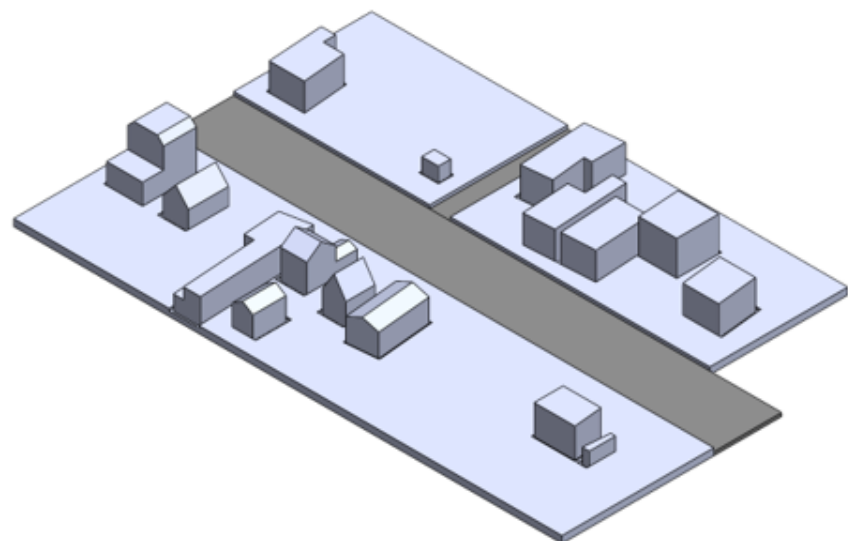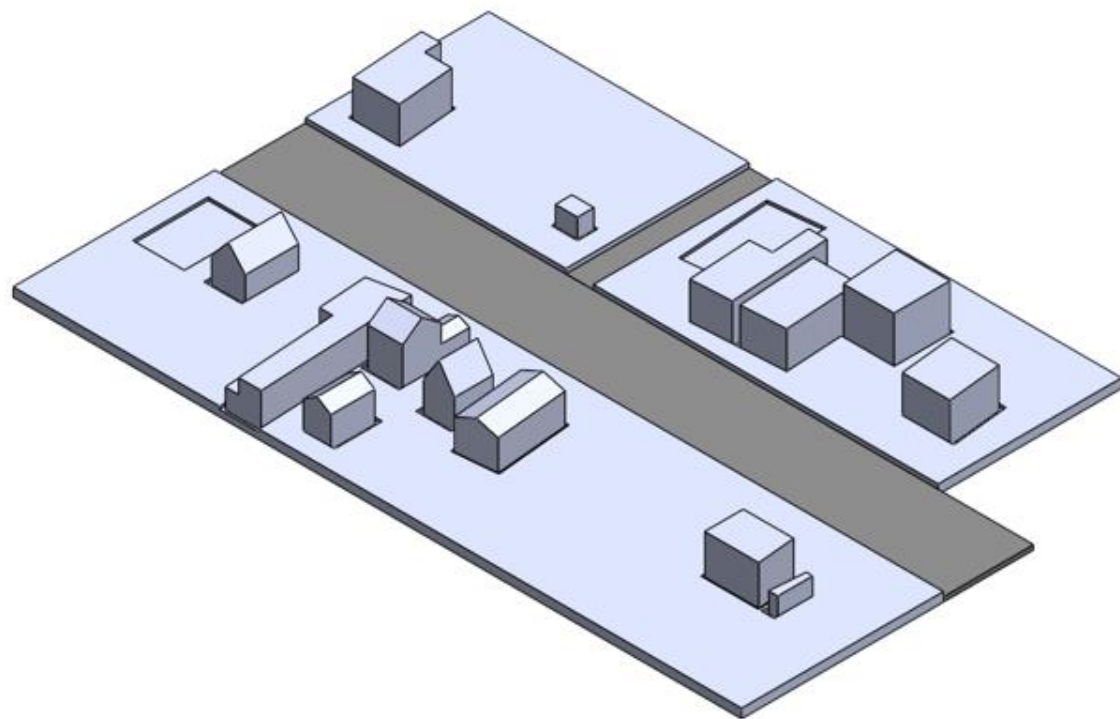
3D Model

2D Model

Q & A

Please join us in asking the interns questions about their projects or program experience.

Town and Country

Kyle Wareham
Mechanical Engineering

Zachary D'Antonio
Mechanical Engineering

Luke Franks
Electrical Engineering

Gianna Lattanzio
Chemical Engineering

Project Overview

Project: City Efficiency/Tracking

- **Contact:**
  - Jordan Karim, City of Youngstown
- **Problem/Challenge:**
  - The City of Youngstown manages more than 400 lane miles of road
  - Manages a water department, wastewater treatment plant, fleets of vehicles (snowplows, water department trucks, police cruisers, etc.)
  - Infrastructure for a city meant to grow to more than 250,000 residents
- **Project Description:**
  - The product will deliver tangible information or plans that the city can use to increase efficiency and save local tax dollars.

Our Interpretation

Road maintenance is an important part of maintaining a community.
- Data for hundreds of miles of roads is costly
- Data acquisition is time consuming

Other Products

Other solutions developed to combat issue:

- Apps utilizing sensors in smartphones
- AI software
- Website reporting systems

While these solutions do work, they either do not collect enough data or are not cost - efficient

Apps Based Detection System

Benefits	• Easy to use • Not intrusive on user
Flaws	• Phone must always have app open • Data points are limited by the car's suspension

AI Based Detection System

Benefits	• Effectively detects current potholes
Flaws	• Rates for companies are expensive • Cannot detect subtle bumps

Website Reporting System

Benefits	• Low cost
Flaws	• Dependent on user input • Requires manpower to analyze data • Information isn't always used
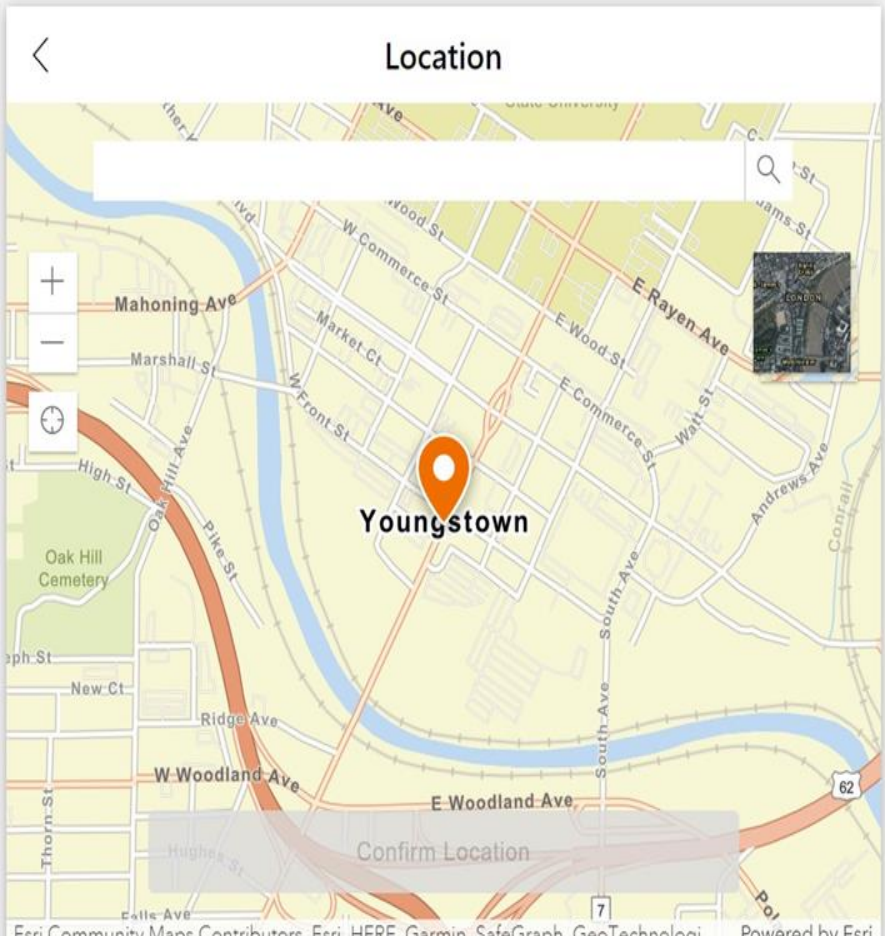
This is the current method used in the city of Youngstown.
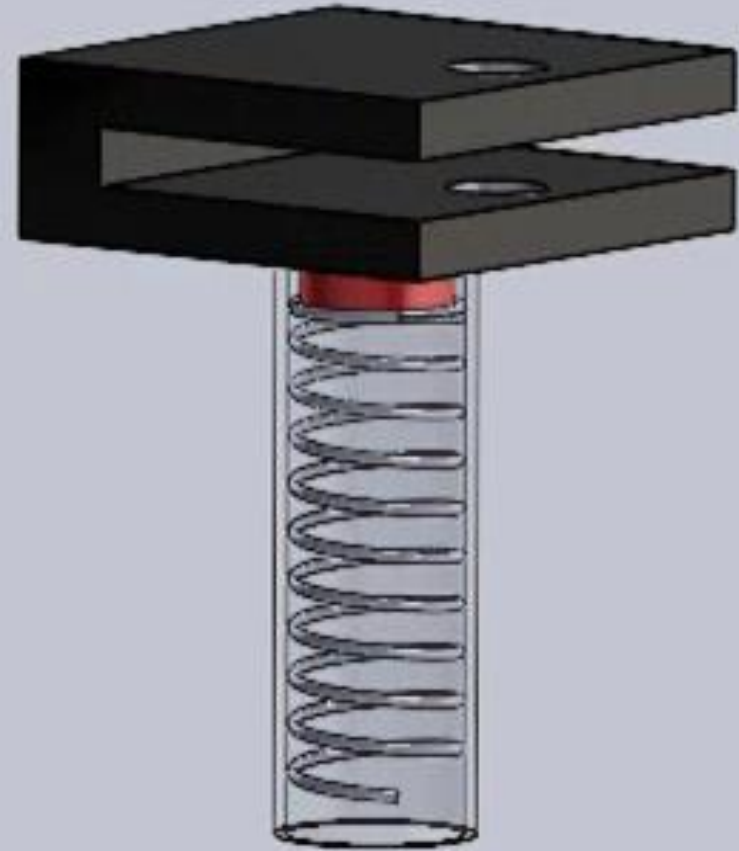
Initial Designs

Rod encased by springs mounted to shocks that triggers a button

- Difficult calibration
- Too high risk for damage
- Hard to install

economic
ACTION group inc.

Y YOUNGSTOWN STATE UNIVERSITY

Initial Designs

DOI Accelerometer that would attach to shocks of vehicle

- Requires extensive testing
- Likely to break
- Inaccurate/Limited data
- Uses liquid mercury
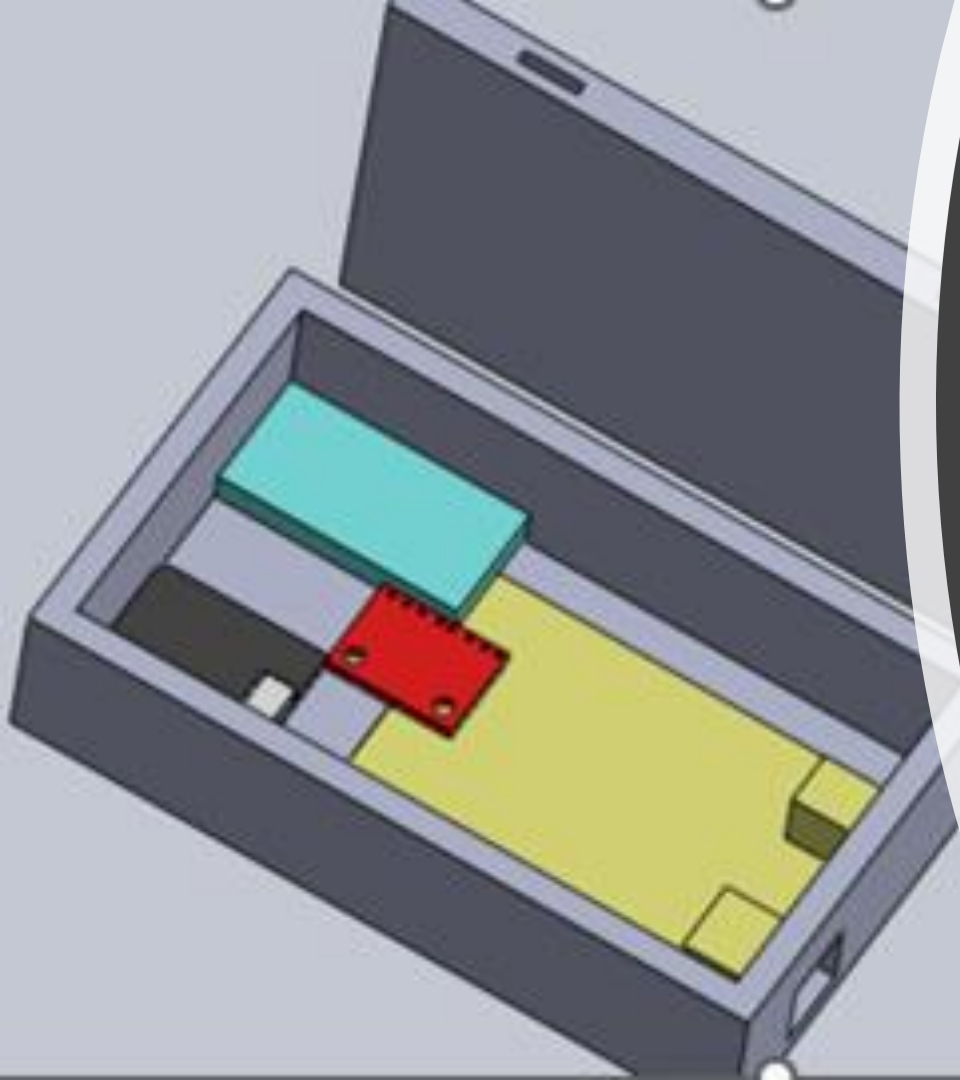
Final Designs - SIMUN

Our final solution is SIMUN. SIMUN uses the following components to detect and record potholes:

- MPU 6050 accelerometer (Red)
- NEO 6M GPS module (Black)
- Arduino Uno (Yellow)
- SD Card Reader (Blue)

SIMUN is directly mounted to the shocks of a car with the help of plastic zip-ties. A USB cord is used to power SIMUN.

Code

```
#include <Adafruit_MPU6050.h>
#include <Adafruit_Sensor.h>
#include <Wire.h>
#include <TinyGPS++.h>
#include <SoftwareSerial.h>
#include <SD.h>
long timer = 0;


int CS = 10;
File myFile;

static const int RXPin = 4, TXPin = 3;
static const uint32_t GPSBaud = 9600;
const unsigned long eventInterval = 1000;
unsigned long previousTime = 0;

// The TinyGPS++ object
TinyGPSPlus gps;

// The serial connection to the GPS device
SoftwareSerial ss(RXPin, TXPin);

Adafruit_MPU6050 mpu;

void setup(){
  Serial.begin(9600);
  ss.begin(GPSBaud);
  pinMode(CS, OUTPUT);
  mpu.begin();
  SD.begin();
  mpu.setAccelerometerRange(MPU6050_RANGE_16_G);
}
```

- Libraries and languages needed for Arduino to communicate with other components

- General setup for all the components needed

- Initialization of components and setting accelerometer detection range

```
void loop(){
  // This sketch displays information every time a new sentence is correctly encoded.
  sensors_event_t a, g, temp;
  mpu.getEvent(&a, &g, &temp);
  timer = millis();

  unsigned long currentTime = millis();
if (currentTime - previousTime >= 2000)
  while (ss.available() > 0){
    gps.encode(ss.read());

    if (gps.location.isUpdated()){

    myFile = SD.open("test.txt", FILE_WRITE);
    if (myFile){
      Serial.print(" ");
      Serial.print(gps.location.lat(), 6);
      Serial.print(" ");
      Serial.println(gps.location.lng(), 6);
      myFile.print(" ");
      myFile.print(gps.location.lat(), 6);
      myFile.print(" ");
      myFile.print(gps.location.lng(), 6);
      myFile.print(" ");
      myFile.println(a.acceleration.z / 9.81);
      myFile.close();

    }
  }
}
```

- Setting a timer so code takes a point every 2 seconds to keep track of roads travelled

- This tells the Arduino to acquire the text data every 2 seconds and write it to the SD card so we can read and manipulate it

```
if (a.acceleration.z/9.81 > 1.4 || a.acceleration.z/9.81 < -1.4)
  {

    myFile = SD.open("test.txt", FILE_WRITE);
    if (myFile){

      myFile.print(" ");
      myFile.print(gps.location.lat(), 6);
      myFile.print(" ");
      myFile.print(gps.location.lng(), 6);
      myFile.print( " ");
      myFile.println(a.acceleration.z / 9.81);
      myFile.close();

  }}
}
```

- Telling arduino to collect the data points that are more severe, +-1.4 g's

- Telling arduino to write the information to the SD card
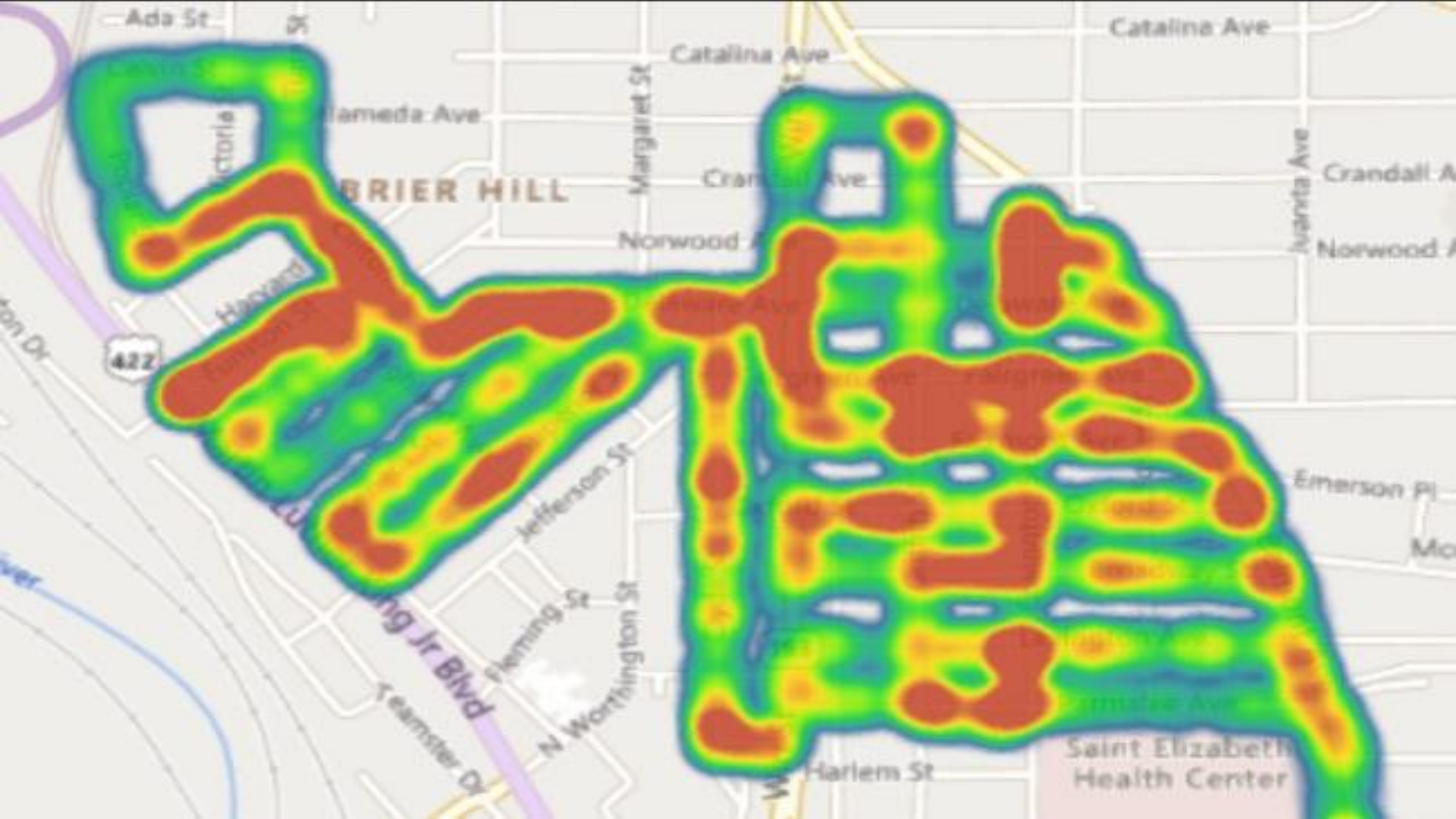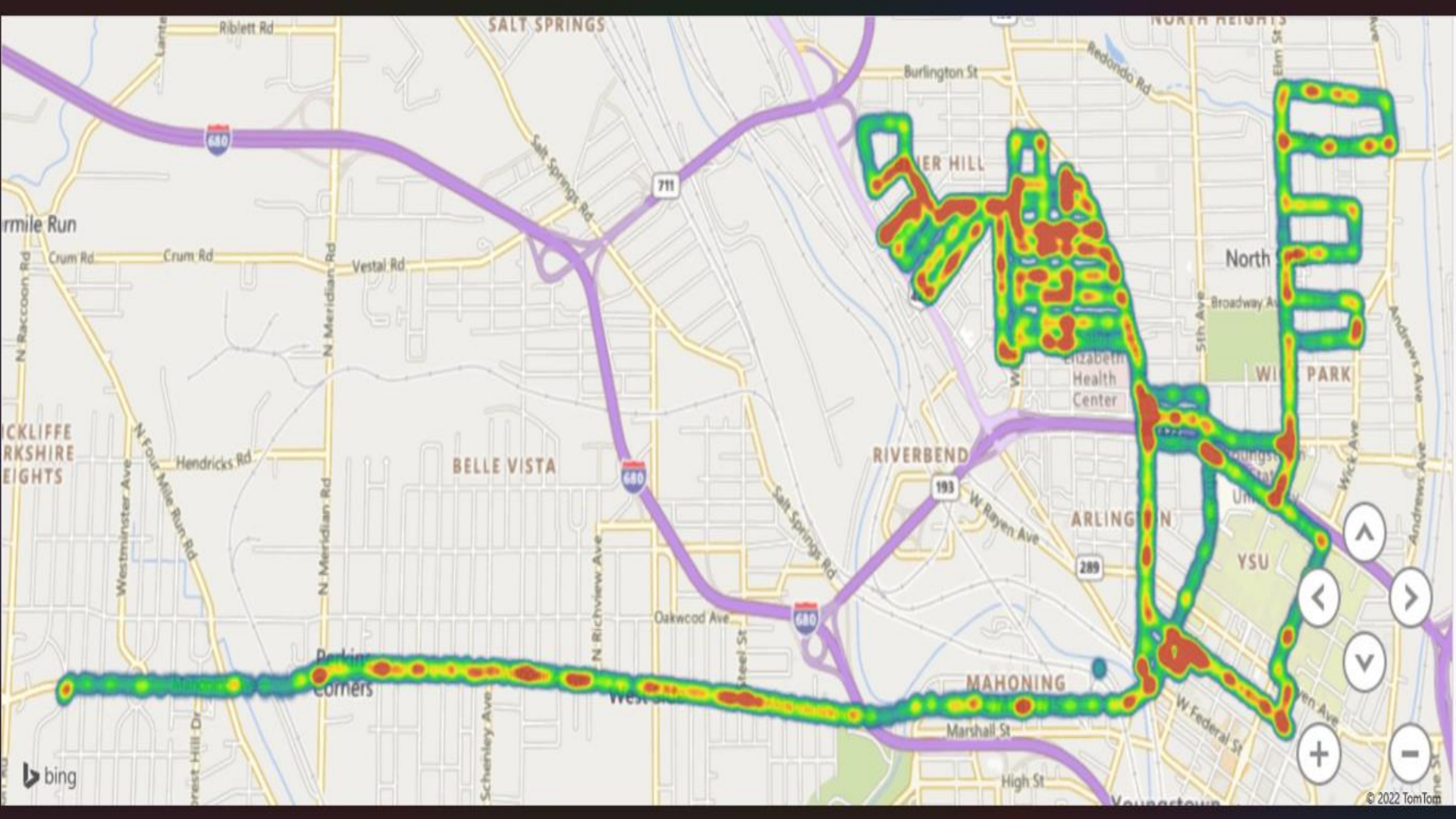
Examples of Data-Green Sections

Examples of Data-Yellow Sections

Examples of Data-Red Sections

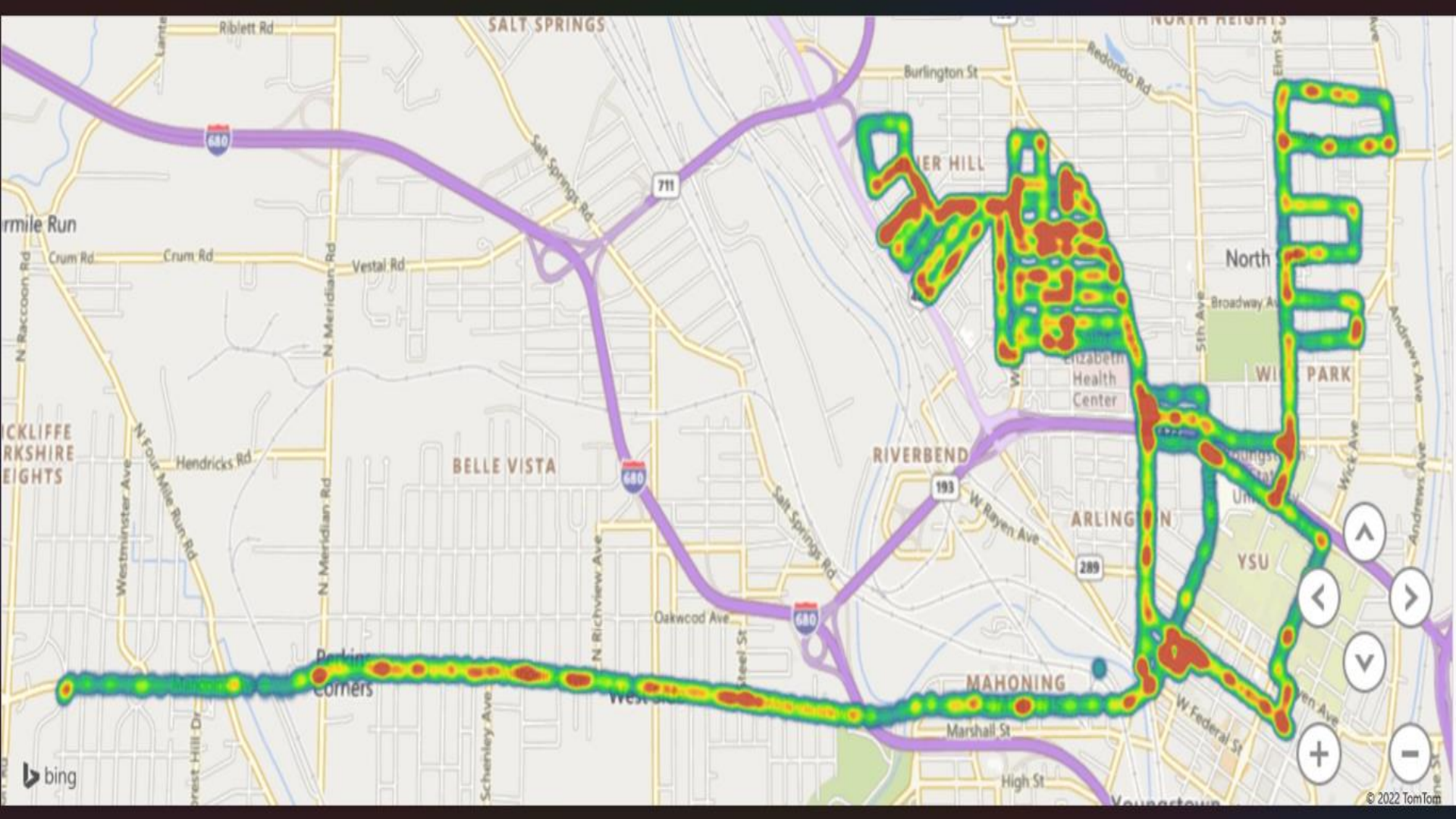# Potential Users of SIMUN

- Local Government
- Waste Management
- Transit Authority
- YSU
- YPD
- Local Businesses

Cost of SIMUN

Component	Cost	Quantity	Cost per Unit
GPS Module	12.00	1	12.00
Micro SD Module	7.00	5	1.40
Arduino Uno	24.00	1	24.00
Accelerometer	10.00	3	3.33
Micro SD Cards	35.00	10	3.50
6ft USB Cord	61.00	24	2.54
Housing	12.00	1	12.00
Total			60.77

Future Developments

Provide more options for power	Improve mechanical design
• Connected to cigarette port • Connect directly to fuse box • Battery power	• 3D Print Housing • Incorporate metal zip-ties • Improve the size of SIMUN

Websites

https://data.census.gov/cedsci/profile?g=1600000US3988000

https://www.roadbotics.com/

http://www.streetbump.org/

Websites

https://www.google.com/maps/place/Brier+Hill+Youngstown+Ohio

https://www.youngstownohio.gov/

https://bdiadditive.com/

Q & A

Please join us in asking the interns questions about their projects or program experience.

Thank you for attending!
We hope you enjoyed the final presentations!
Please feel free to join us back in the automation and robotics lab for comments and discussion.