El Bache: The solution to potholes in Michigan

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ABSTRACT:

If you have ever driven in Michigan, you have probably experienced the disastrous potholes and the damaging effects they have on road going cars. With the State’s obnoxious weather, the roads are constantly becoming worse and worse. The state of Michigan does not have the money and time to fix all the roads every year. Instead, they are filling the potholes with asphalt. Even though it is a fast and easy solution, in only three to four years, the asphalt should be replaced in order to prevent cracks from becoming potholes. We thought that advancing the abilities of the cars will be a great solution.

This project was developed in order to have the cars we drive aware of potholes and to avoid them while also being aware of their surroundings. Even though it was not a complete robot due to a lack of time, we did succeed in having the robot avoid a pothole and stop once it saw either cars or passengers walking on the road. In order for our robot to do that, we used two sensors, each programmed differently. The first one was in charge of looking for the potholes and signaling the car to move to the next lane, while the second sensor was to make sure the car stopped if there was any traffic on the road. The detailed design process will be later explained.

INTRODUCTION

Potholes are created when snow and ice melt. Moisture seeps into the pavement, freezes, expands and thaws, creating a gap in the pavement. As vehicles drive over the gap, the pavement weakens which leads to the creation of a pothole. According to the Michigan Department of Transportation, pothole repairs represents a significant portion of MDOT’s annual maintenance budget. In the fiscal year of 2017, the potholes cost Michiganders over 8 million dollars. The total cost of the pothole repairs over the last five fiscal years came to over 70 million dollars, which is a huge amount of money that could have been spent on other problems Michiganders face such as poverty and unemployment.
Patent One

Title: Machine Vision for Predictive Suspension
Patent Number: US20090097038A1

Pros:
1. May detect bumps, potholes or other surface irregularities in front of the tires of a vehicle and adjust or control the suspension system of the vehicle.
2. It detects the distance to the surface irregularity and estimates the time it will take to reach the detected surface irregularity.

Cons:
1. Making the camera detect the distance the vehicle is from a pothole will take many hours to work on.
2. The sensors will be difficult to connect to the cameras to warn the drivers.

Patent Two

Title: System and method for sensing and managing pothole location and pothole characteristics
Patent Number: US 2014/0196529 A1

Cons:
1. Expensive; it requires Aerial platform data sources.

Pros:
1. Creates an efficient and routine pothole management scheme.
Patent Three

Title: Pothole Detection
Patent Number: US9626763B1
Sketch:

Pros:
- Shows where big potholes are for a repair
- Consistent repairs
- Opens jobs

Cons:
- Amount of time before repair
- Signal can be altered
- Amount of potholes

Patent Four

Name: Pothole Detection System
Link Online: https://www.landrover.com/experiences/news/pothole-detection.html
Picture:

Pros:
- Gives location and severity of potholes
- Adjusts the vehicle’s suspension characteristics
- Comfortable drive

Cons:
- Expensive
- What happens if the sensor breaks?
DESIGN PROCESS

With the help of the previous robot models, we have been able to modify and develop one of the robots to suit the work of our project. What we’ve focused on is the number of sensors we need in order for the robot to avoid holes as well as avoid any object intercepting its way. We also worked on how to put sensors in appropriate places so that they can read the required distances correctly. The idea of placing two sensors was appropriate for the robot to function better. One is bent on the floor and the other is directed directly to the robot’s front. Because the reading of the floor sensor was larger than what we needed, we partially covered the sensor responsible for looking for holes in order to limit its long distance reading and focus only on the floor.
CONCLUSION

The idea of our project came from the pothole problem that most people suffered from this year. Damages caused by potholes cost U.S. drivers approximately $3 billion a year. When we started our research, we found that The Ford Motor Company used pothole detections to change their cars’ suspension to reduce the harsh impact potholes often deliver. In our project, we used two sensors. One of the sensors worked as a pothole detector to change the route of the vehicle while the other sensor worked to detect other objects like pedestrians. We kept testing and changing the distance for each sensor to determine how far the car should stop before the pothole and the objects. In the future, we can add more sensors on the sides to detect the objects beside the vehicle.