

Pothole Detection System

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1. Motivation:

Considering that we use the roads in the cities we live in, we all deal with potholes on a daily basis. Between 50% and 70% of the roads in big cities are in a damaged state. Since the recycling rate of spare parts of these vehicles is less than 1%, the precaution that can be taken is to prevent these damages and losses.

Beyond a financial hardship, potholes can cause a variety of accidents and problems even for the most experienced drivers. , but government data state that the number of accidents due to potholes on roads has increased over the past two years.

2. Problem Statement:

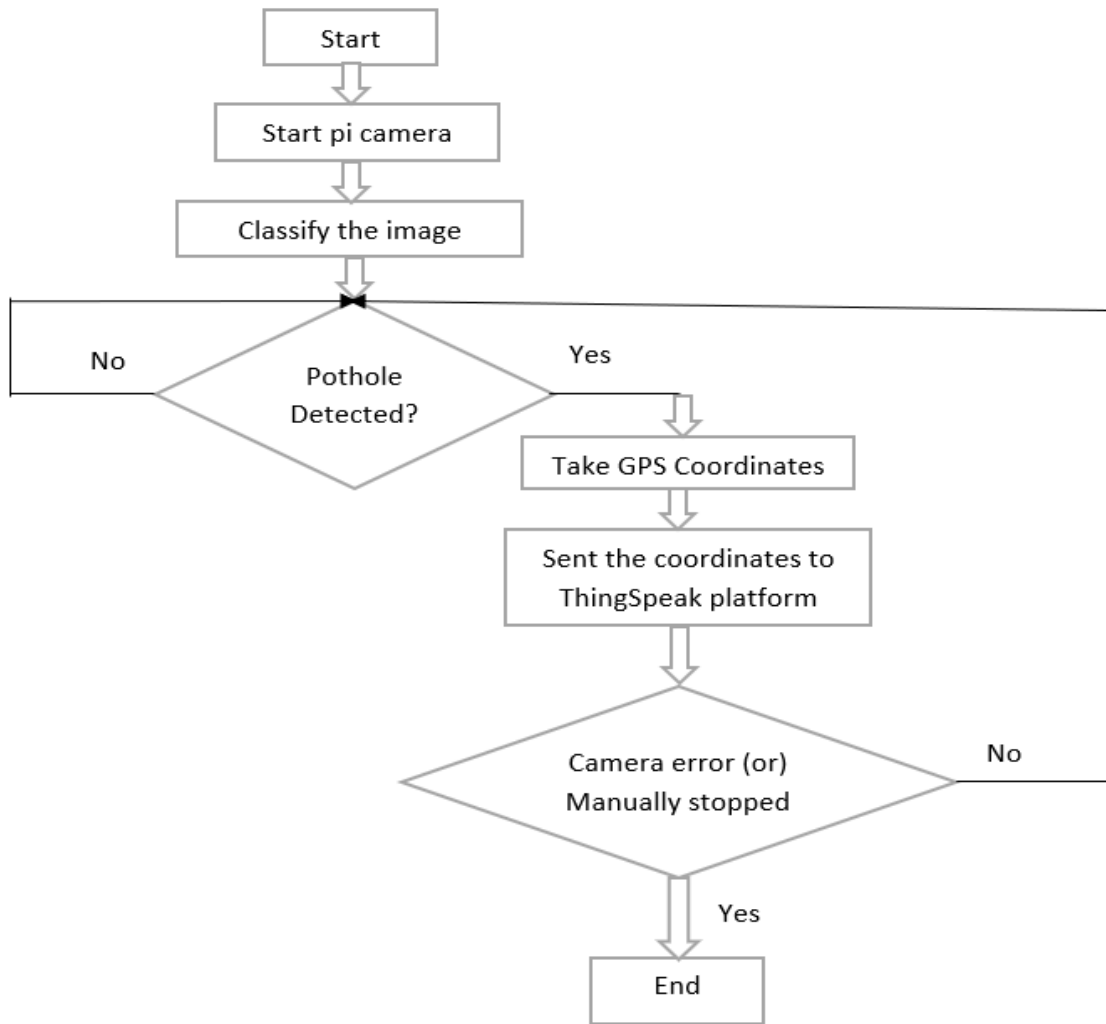
Road accidents by potholes cause thousands of death in India. Government authorities takes a lot of time to find these potholes and fix it.

- In pilot vehicle(garbage van) which will be commuting in the city,
 - The camera connected to the Raspberry Pi will detect the potholes
 - GPS Coordinates of those potholes detected by GPS module will be sent to the ThingSpeak platform.
- In user mobile phone,
 - A map webpage in which the user can view the potholes.
 - When the user is near the pothole, alert sound will be played, based on mobile phone's location.

3. Design Procedure:

Choice of Components:

1. Raspberry Pi 3 – As image detection is involved, it is implementable in python using YOLOv4 module in OpenCV package
2. USB camera – As the camera should be placed in front of the vehicle but the picamera is attached with the raspberry pi board, USB camera is best suited for this application.
3. NEO 6M GPS Module - Unlike other GPS modules, this can perform 5 location updates in a second with 2.5m position accuracy and strong satellite search capability.



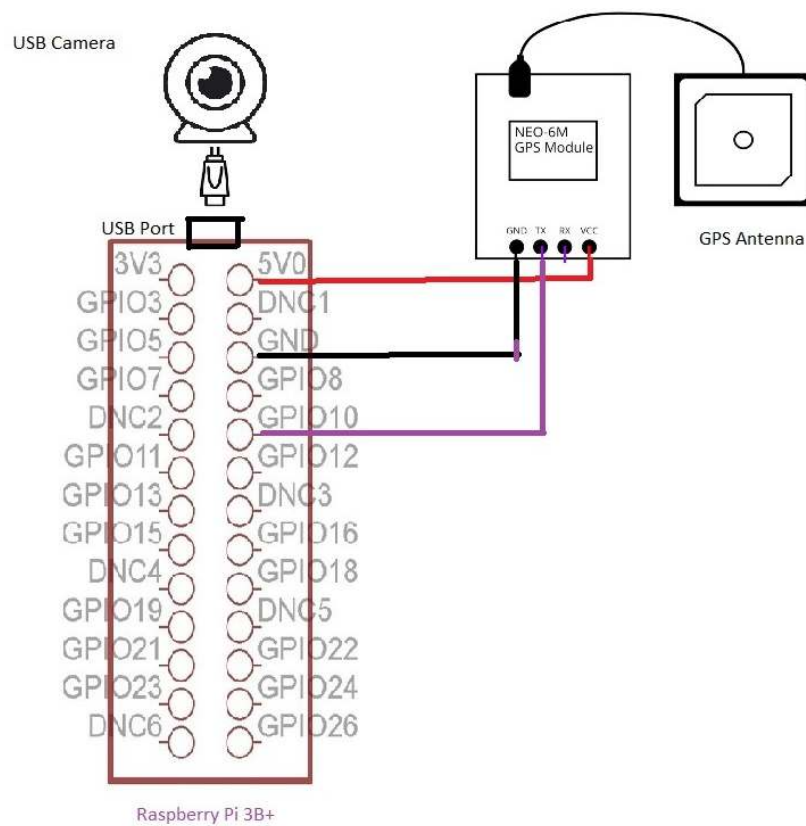
Flow chart of the detection process in the pilot vehicle

- End user just need a mobile phone in which one can open the website and will be alerted while travelling in the region of pothole.

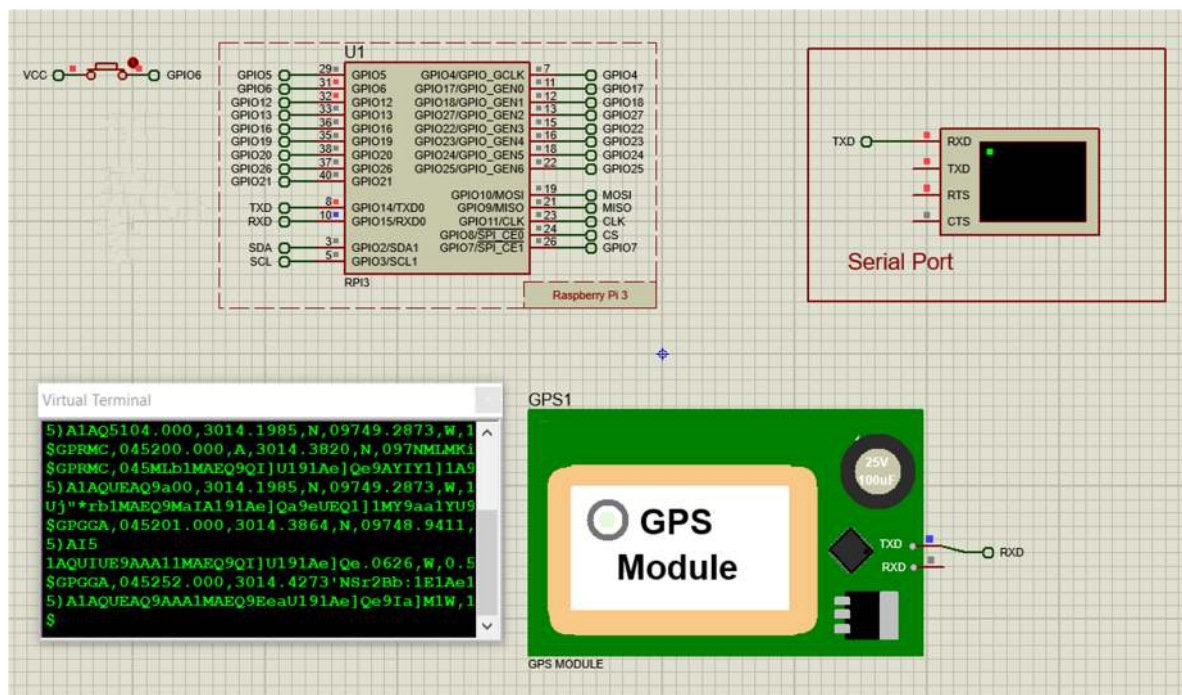
4. Budget:

S. No.	Component Name	Quantity	Price (in Rupees)
1.	Raspberry Pi 3B+	1	6000
2.	NEO-6M GPS Module	1	450
3.	Logitech C270 USB Webcam	1	2100
4.	Jumper wires	3	10

5. Circuit Diagram / Board Layout / Schematic:



6. Simulation Results / Discussion:



Simulation of the project in Proteus 8 simulation software

	A	B	C
1	Coordinates	Latitude	Longitude
2	1	10.903167	76.898259
3	2	10.903167	76.898273
4	3	10.903171	76.898277
5	4	10.903173	76.898282
6	5	10.903165	76.898279

GPS Coordinates of the potholes from simulation

7. Implementation / Prototyping results:



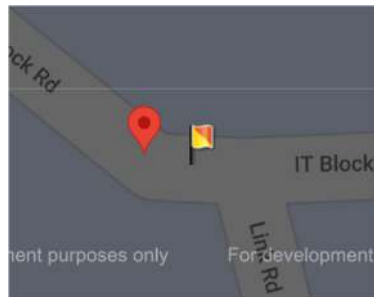
Pothole GPS Coordinates logged in ThingSpeak platform



Prototype of the pilot vehicle

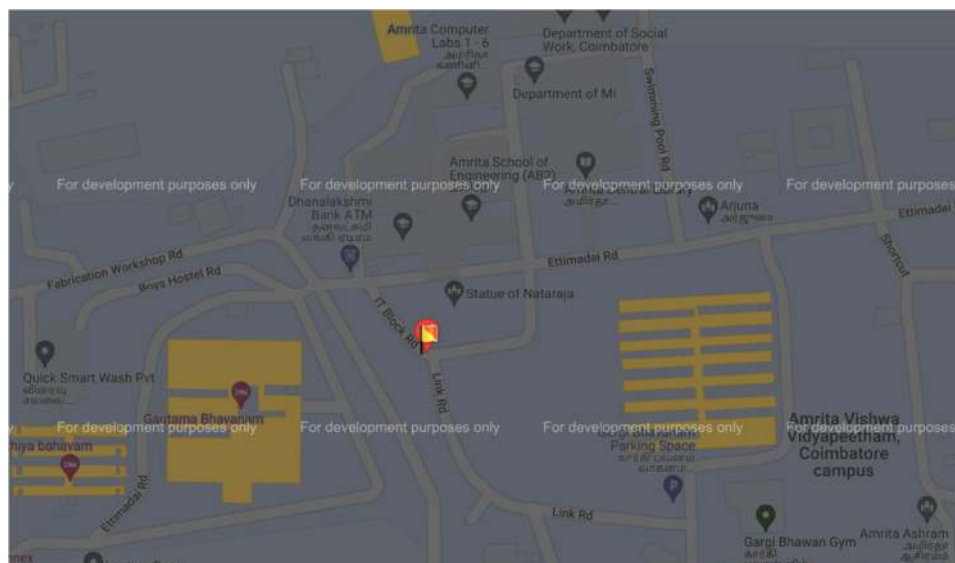


Input and Output images from YOLOv4 model which detects pothole



Map which show the potholes and alert the user,

- Flag – pothole
- Pin – User location



8. Discussion & Conclusions:

Hardware placement and improvement:

- This is practically implementable where power supply for Raspberry pi board is taken from the pilot vehicle battery.
- The USB camera wire length will help to keep the camera in front of the pilot vehicle where picamera couldn't be placed.
- The Raspberry Pi board could be accessed from anywhere in the world with the help of screen sharing services provided by Virtual Network Computing(VNC) Software through cloud computing.
- Higher frame rate for USB camera will be achieved if Raspberry pi 4 is being used and powered from pilot vehicle battery.

Implementation:

- Government officers could connect to the Raspberry Pi board through VNC viewer from the computer in office and run the code when the pilot vehicle starts commuting the city.
- Then, the coordinates could be taken from ThingSpeak platform by the officers to repair those potholes.

End User Interface:

- While this process happens daily, the map website will be updated with all the potholes in the city.
- This website helps the user to evade the pothole by slowing down the vehicle when the alert sound is played.