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An Efficient and Cost Effective IoT Based Solution for Bump Detection System

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***Abstract*— Prior detection of speed bumps enables drivers and the vehicle suspension system to respond before driving over them. This can avoid poor driving experience, damage to the car and, in serious cases, injuries. Due to speed bumps, we pay for maintenance, car damage, and someone's life. So as a solution we developed the Bump detection and Accident prevention using IoT. In this proposed idea we are using a gyroscope sensor to watch the car's movements and detect the pattern of bump, after the bump is detected, the location details of the bump go to the server, then the coordinates are located on the map for other users. So that they are aware of the bump beforehand and take appropriate action.**

1. INTRODUCTION

The Internet of Things (IoT) is a recent paradigm of communication in which everyday objects are supposed to be able to send and receive digital information to create interactions between machines and human machines. This idea would make it easier to access and communicate with all kinds of things, from home appliances to devices for tracking, smartphones, wearables, cars, and so on. [1].

With this new and cheaper ways to solve concerns that otherwise would have been highly resource based are being proposed through the democratization of technology. Recently, the use of ordinary cars as part of sensing systems to track destructive incidents such as potholes, cracks, speed bumps and other irregularities in transport infrastructure has been growing in interest. e.g., roads, streets, boulevards, and highways.

Speed bumps have been a cause of worry for motorists for a long time. One of the most common driving problems is to not be fully aware of bumps location. In 2014, 11,000 people were killed by potholes and speed breakers, according to the Road Accident Report (2014) released by the Department of Road Transport and Highways. Due to speed bumps, we pay for maintenance, car damage, and someone's life. So as a solution we developed the Bump detection and Accident prevention using iot. It detects each bump and locates it on the map for the next user. This system is especially for social purposes. It will help to prevent accidents from bumps. This can prevent unfortunate things from happening and can also reduce the maintenance cost of the vehicle. The location data can also be used by Ambulance to find the path which has fewer or no bumps, so the critical patients can be taken to hospitals with safety and without danger of bumps. It prevents emergency breaks and maintains the vehicle's health and prevents accidents. Sudden high-speed bumps cause injury to transit patients, pregnant women, and rapid wear and tear to vehicles. This system is proposed to overcome this problem that detects on road bumps by using IMU sensors.

Our contribution to this research is to propose a system at a low cost and gives better accuracy based on the success of IoT in building smart solutions for road safety. The proposed system is developed to alert the driver beforehand for safety and better driving. In this proposed system, the system gathers information from the 6-axis gyroscope and GPS sensor mounted in the car, after the identification of a bump, it's location is sent to the server and located on the map, so when another user passes from that road it generates an alert for any nearby bump.

Some important objectives about the system are:

- Provide alerts about bumps so users are aware about bumps.
- Provides 99.9% acknowledgement about bumps.
- No worries about car damage.
- Aware about bumps gives less accident chances.
- Any person having some medical injuries are safe.

Uneven street surfaces, potholes, and speed bumps can cause cars to lose balance especially whilst the driver isn't attentive or careful while meeting such challenges. To have an easy and comfortable ride, it is essential to have a responsive vehicle suspension device that may get hold of entering from the smart sensors to make the required adjustments. Due to speed bumps, we pay for maintenance, car damage, and someone's life. So as a solution we developed the Bump detection and Accident prevention

using iot. It detects each bump and locates it on the map for the next user. This system is especially for social purposes. It will help to prevent accidents from bumps. We used Gyroscope Sensor and GPS for getting the location, which is then sent to the server, and next time, if any user is on the same path, he gets a warning if there are any bumps near the car, and this can prevent the unfortunate things from happening, and can also reduce the maintenance cost of the vehicle. The location data can also be used by Ambulance to find the path which has fewer or no bumps, so the critical patients can be taken to hospitals with safety and without danger of bumps.

2. LITERATURE SURVEY

Table 2.1: Literature Review

Author	Appearance		
	Approach	Year	Performance
Sandeep Shah [1]	Convolution Neural Networks	2019	95% Accuracy from 5-8 meters
Kwang Ming Lion [2]	Kinect Sensor, Image Recognition	2018	86.84% Accuracy of Height
K P Varma [3]	Deep Learning using GPU and ZED Stereo Camera	2018	Detection accuracy is 97.44%
Moreno, Escalante [4]	Accelerometer, GPS	2017	91%

Some researchers have already been working on road surface condition detection, Martin et al.[2] suggested a computer vision speed bumps detection device. Using a combination of disparity diagram, Canny filter, color recognition, and eventually, changing the right image captured to one side, their identification technique is used. The photos were captured with two USB web cameras where one image is captured first after the other. By applying the Canny calculation to classify the lower edge of the obstacles, the two pictures were then modified. Erickson et al. [3] A device called Pothole Patrol was implemented that takes advantage of the presence of data beyond the z-axis, even using the accelerometer's x-axis. The identifiable evidence of potholes achieved an accuracy of 92.4 percent. Sandeep Shah [4] presented a system, which was able to detect speed bumps, using image recognition, where he used Convolution Neural Networks (CNN), and got the accuracy of 95% from a distance of 5 to 8 meters. Kwang Ming Lion[5] presented Kinect sensor study, Kinect is a line of motion sensing input devices manufactured by Microsoft, it is an integration of RGB cameras, depth sensors and infrared sensors, this method has been able to identify potholes and speed bumps with an accuracy of 86.84%. K P Varma [6] proposed a system, where he used Deep learning using GPU and ZED Stereo Camera, which was quite expensive, but the accuracy of the system was impressive. i.e., A similar method was used by 97.44% of Moreno Escalante[7], where bumps were detected using accelerometer and GPS, using 3 degrees of freedom, i.e. X-axis, Y-axis and Z-axis, where bumps were detected using the rotation of the vehicle on that axis.

3. PROPOSED METHODOLOGY

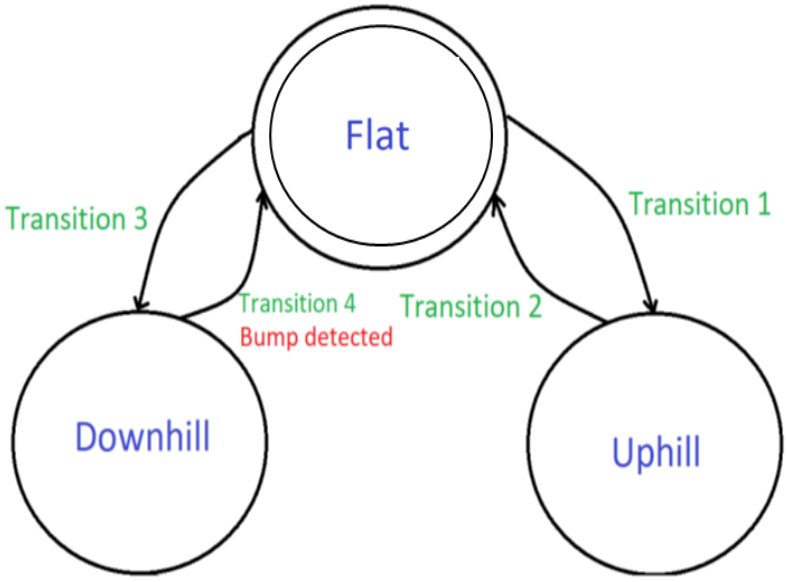

Fig. 3.1 State Transition Diagram

In the Proposed System, we use a generic way based upon Finite State Machine in order to detect bumps. It is observed that when a car passes over a bump, its body has 4 main transitions.

Initially, Car is in flat state while driving, when a bump comes, the front wheels go up on the bump, at this time the car transitions from flat state to Uphill state (Transition 1), then the cars moves forward and the front two wheels comes down from the bump, now the car transitions from Uphill state, back to flat state (Transition 2), then the car move and now the back wheels go up

on the bump, car transitions from Flat state to Downhill State (Transition 3), after that the back wheels come down from bump, and car transitions from Downhill state to Flat state (Transition 4), So basically this 4 transition takes place whenever a cars passes over a bump.

But this approach has a drawback, Even after using finite state machine for detecting bumps we observed that bridges also makes car body goes through this 4 transitions, The solution was to specify a maximum period through which if the car passes through the 4 transitions then there is a bump and it's going to be detected , if it has gone through the 4 transitions but in a longer period of time than the specified, then it is not a bump.

We use IMU sensors to detect the movement of the vehicle, meaning that the Inertial Measurement Unit is known as a 9-axis sensor that measures the forces of orientation, velocity, and gravity by combining Accelerometer, Gyroscope, and Magnetometer into one. IMUs usually come in big packages, but they are now more frequently seen as miniaturized sensors built for easy integration with Arduino or other microcontrollers with recent inventions such as MEMS technology.

4. EXPERIMENTAL SETUP

In this proposed idea we are using a gyroscope sensor to watch the car's movement and detect the pattern of a bump. We used a generic way based on the Finite State Machine to detect bumps. We observed that whenever a car passes over a bump its body has 4 main transitions car transitions from flat state to Uphill state (Transition 1), then the cars moves forward and the front two wheels comes down from the bump, now the car transitions from Uphill state, back to flat state (Transition 2), then the car move and now the back wheels go up on the bump, car transitions from Flat state to Downhill State (Transition 3), after that the back wheels come down from bump, and car transitions from Downhill state to Flat state (Transition 4). The NodeMCU is connected to the IMU sensor and GPS.

After the bump is detected, Bump's location will be sent to the server. This location will be used to warn other users who are using the same path (500-100) meters before reaching the Bump through mobile application. Users will get warning through an Application installed on their smartphone that can prevent the unfortunate things from happening and can also reduce the maintenance cost of the vehicle.

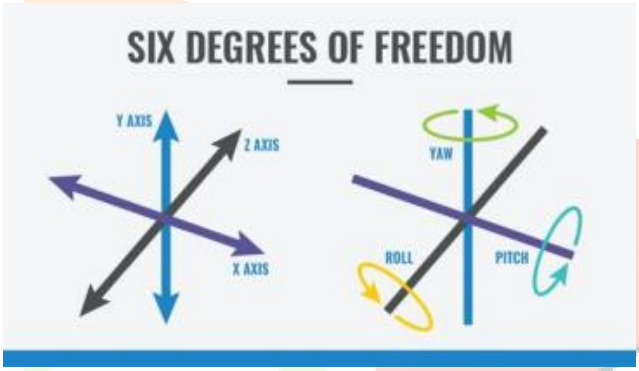

Fig. 4.1 Six Degrees of Freedom

To detect the motion of the vehicle, we are using IMU sensor, IMU, meaning for Inertial Measurement Unit is known as a 9-axis sensor that measures direction, velocity, and magnetic acceleration by combining Accelerometer, Gyroscope, and Magnetometer as one. Typically, IMUs come in big packages, but with recent advancements like MEMS technology, they are now more commonly seen as miniaturized sensors designed for easy integration with Arduino or other microcontrollers Position of the bumps are captured using a GPS sensor (BU-353-S4), which is fast with the frequency of 1 Hz refresh rate. NodeMCU ESP8266 is linked to the IMU sensor and GPS, and NodeMCU is a low-cost open source IoT platform. Initially, it included firmware running on Articulate Systems' ESP8266 Wi-Fi SoC, and hardware based on the ESP-12 module.

After the Bump is detected, Bump's location is sent to server, GPS is used to get the coordinates of the bump, after receiving the location, then bumps are located on the Map for other users, whenever the other user passes over the same road, the user is warned about the bumps beforehand, about 500-100 meters before reaching to the Bump via a mobile application, it can be voice notification or beep sound

5. CONCLUSION

We have suggested a method of speed bump detection in this system using Gyroscope Sensor and GPS to get the location, which is then sent to server, and next time, if any user is on the same path, he gets warning if there is any bumps near by the car, and this can prevent the unfortunate things from happening, and can also reduce the maintenance cost of the vehicle.

The location data can also be used by Ambulance to find the path which have less or no bumps, so the critical patients can be taken to hospitals with safety and without danger of bumps.

6. REFERENCES

[1] Zanella, A.; Bui, N.; Castellani, A.; Vangelista, L.; Zorzi, M. Internet of things for smart cities. IEEE Internet Things J. 2014, 1, 22–32 .

[2] A. L. J. MARTIN, C. CRUZ, "Speed booms detection for a ground vehicle with computer vision," 12th WSEAS Int. Conf. Math. Comput. Methods Sci. Eng., pp. 258–264, 2010.

[3] J. Eriksson, L. Girod, B. Hull, R. Newton, S. Madden, and H. Balakrishnan, "The POTHOLE PATROL: Using a mobile sensor network for road surface monitoring," in Proc. 6th Int. Conf. Mobile Syst., Appl., Services, 2008, pp. 29–39.

[4] Sandeep Shah & Chandrakant Deshmukh (2019), Pothole and Bump detection USING CONVOLUTION Neural Networks. vol. 6, no. 10.

[5] Kwang Ming Lion & Kae Hsiang Kwong (2018), Smart Speed Bump Detection and ESTIMATION WITH Kinect. Res. ICCIC 2018.