1. Introduction
2. Problem

Today's transportation system has been well developed. People can find the route to a specific destination through navigation, which provides a lot of convenience. But the problem is that the road condition is changing all the time, but we can't get the information of real-time road condition. Because the traditional road monitoring is carried out regularly through special vehicles, and it needs a lot of cost. In the blank period of monitoring, if there are serious changes in the road surface somewhere, it may affect the comfort and safety of passing vehicles, and even force vehicles to change the route, which wastes a lot of time. Therefore, we need a lower cost and more efficient seamless pavement monitoring device.

1. Solution

We propose a device composed of acceleration sensor, GPS and independent power supply, with supporting mobile applications on smart phones. The device can be placed on a bicycle or vehicle and transmit the position information and corresponding sensor data to the server in real time. By filtering, processing and extracting features of sensor data, the application can display intuitive road condition data. As a portable and low-cost monitoring device, we can equip it with a large number of vehicles or public bicycles. In this way, the road condition of the road section can be directly obtained by the vehicles passing through the road section and provided to other users, so that everyone can obtain the real-time road condition and make a reasonable route choice.

1. Physical Design

图示

描述已自动生成

Figure 1: Device Physical Design

1. High-Level Requirements

• The battery of the device needs to have a large capacity to provide enough power to operate normally for long-time driving.

• The server needs a high-precision module to eliminate the sensor noise signals caused by the vehicle itself, such as acceleration, deceleration or turning, so as to provide high-precision road conditions.

• The data transmission between monitoring device and server, server and mobile application should be completed within 500 milliseconds to ensure the real-time and effectiveness of road condition data.

1. Ethics and Safety
2. Ethics

In the development and use of our project, we must avoid violating the ethical breaches in the project. Since our device has GPS positioning function and position is a kind of personal privacy, we must comply with 7.8 IEEE Code of Ethics Section1.1 and ACM Code of Ethics 1.6 to strictly protect the privacy of users, collect only the minimum amount of necessary personal information, prevent accidental data leakage, and timely disclose factors that may endanger the public or the environment.

Moreover, because our data will help users determine the driving route, we must comply with ACM code of ethics 2.9 to establish a safe system to avoid problems caused by system vulnerabilities or unexpected data tampering. The wrong route may affect driving comfort and even safety. And we should conduct due diligence and provide appropriate guidance and remedial measures in case of problems.

1. Safety

In addition, our equipment has some potential safety problems that must be solved in the development process. Our device uses lithium batteries to provide electricity. According to “Safe Practice for Lead Acid and Lithium Batteries” Section III, because lithium battery can provide high current, if it continues to work at high temperature, the battery may be ignited, result in explosion or fire. Therefore, in the process of using the battery, we must strictly abide by the specifications of the battery, which ask us to operate at an appropriate voltage and temperature, and always pay attention to the temperature of the battery to reduce the risk of personal injury or property loss caused by overheating.

Since our device is fixed on the vehicle, the firmness between the device and vehicle is a safety issue that we must consider. If the sudden acceleration or deceleration will cause the device to fly out, it may injure users or pedestrians and lead to a threat to health. Therefore, we will design a fixed support with reasonable structure and materials to fix the equipment. And we will test the firmness of the equipment under different speeds and accelerations to ensure the safety during use.

[1] Ieee.org. 2022. IEEE (Institute of Electrical and Electronics Engineers) Code of Ethics. [online] Available at: <https://www.ieee.org/about/corporate/governance/p7-8.html> [Accessed 14 March 2022].

[2] acm.org. 2022. ACM (Association for Computing Machinery) Code of Ethics and Professional Conduct. [online] Available at: < https://www.acm.org/code-of-ethics> [Accessed 14 March 2022].