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Design and Development of IoT Based Pavement Friction Measurement Device.

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ABSTRACT:

The brakes of your car will be expected to stop you safely and smoothly when you press the brakes. This is one of the most crucial safety features that relies solely on a principle known as skid resistance, or road grip. Skid resistance is the resistance that develops between a wheel of rubber and asphalt pavement as the rubber rolls or slides. The purpose of this paper is to explain the simple science of road grip in simple terms. Children will explore how friction is formed, why roads can get slippery and how engineers test road surfaces to keep drivers safe. Friction is caused by two physical actions: rubber on stones and rubber on small bumps on the road. The influence of water, vehicle speed, weather, tyres and traffic wear on safety is also covered. With heavy traffic the rough rocks become smooth and the road surface becomes slick over time, particularly during a rainstorm. Simple physical measurements, with the help of laser scanning and computer testing, can help road engineers predict when roads need maintenance. These common concepts will help them grasp how well-designed roads keep skidding vehicles safe and prevent deaths on the nation's roadways every day.

INTRODUCTION:

All drivers are familiar with driving on wet days. Rain can result in a smoother road surface, brakes may still not stop the vehicle completely and cars may sometimes slide if they brake too hard. Ever wonder why some roads are slippery and unsafe and others are sticky and safe? The answer is in the rubbing of the wheel tyres with the road surface. In civil engineering, it's known as skid resistance. Tire grip or skid resistance is the force that holds a tire from sliding off of a road surface.

Road grip can be seen as two small surfaces that are touching. Asphalt Roads do not have a completely flat surface. It consists of a large number of small stone rocks with a black sticky substance called bitumen. Take a close look at these stones—there are two different levels of roughness. There are two levels: micro texture and macro texture. Micro-texture is the degree of surface roughness or how rough the surface of the individual rock chips are. Has the texture of fine sand paper to the touch. The second level is called as macro-texture. The larger spaces and holes between the road's stones make up macro-texture.

There are two different levels of texture, each with a different function in the safety of cars. Micro texture provides rubber tyres with traction on the stone surface during driving at slow or medium speed. Macro-texture is similar to the tiny drainage gutters in the tire to get the rain water out from underneath the tire, keeping the rubber on the road. Water can become trapped under the tire of a car when it is driving at high speed on a wet roadway. With poor macro-texture, the pressure of the water rises, and the tire rises up off of the ground. This is called hydroplaning and the driver's steering and braking are lost.

Road engineers make strenuous efforts to keep highways with high value of friction. It is difficult however, to keep roads grippy. As the cars and heavy trucks drive over the road, the roughness of the stones will be permanently decreased. As months and years pass rough edges of rock leave their mark on the road surface, just as the edges of rocks become smooth in a river bed over time. Weather is also a big factor: hot summer heat, freezing during the winter, dirt, oil spills and other factors continuously change road grip. This introduction sets the groundwork of the importance of studying the characteristics of road friction for public transportation safety and accident prevention.

LITERATURE REVIEW :

The scientific literature reveals that there are three main issues that should be addressed to gain an understanding of road friction: physical understanding of the mechanisms of friction, measurement of friction by engineers, and factors that affect the degradation of road friction over time.

First, researchers tell us that there are two basic mechanical mechanisms that are the foundation of tire friction: adhesion and hysteresis. Adhesion occurs when rubber molecules, temporarily, attach to stone surfaces. It is most effective on dry roads or at lower speeds. Hysteresis occurs when the flexible rubber of tyres is compressed and flexed as it passes over rough stone bumps. When the rubber passes over these stone bumps, energy is absorbed and thus friction force is generated. Hysteresis forms the largest contribution to stopping power on wet or fast highways.

Secondly, the measurement of road friction has changed drastically over the years. Initial research was conducted using basic tools such as the British Pendulum Tester that was operated by hand. It is a device that is used to test the friction at any given point on the wet surface by swinging a small rubber

slider across the surface. To test long stretches of highway at actual driving speeds, engineers created trailer-based testing machines, such as the Locked Wheel Tester and sideway-force vehicles. With these trailers, water is gently dispersed onto the road, a testing tire is locked in place and the resistance the road offers up is recorded. Recently, high-speed laser scanners and 3D surface cameras were added. Instruments such as the Circular Track Meter measure the road level's actual profile of aggregate bumps and automatically calculate the road roughness profile metrics.

Thirdly, new scientific research shows that the coefficient of road grip varies continuously with the life of a road. The new asphalt surface is just a little slick when fresh, due to a thin layer of liquid asphalt binder that is on the top of the stones. Once the traffic has been applied for a couple of weeks, this oily coating is rubbed down by the wheels, and the rough stones below become visible, which improves grip. Over time as traffic increases, however, the aggregate rocks become smoothed out by heavy vehicles, thus reducing the micro texture. Weather is also responsible for seasonal changes in road grip, researchers say. In the summer when the rain is scarce, dust, rubber particles and motor oil accumulate on the road surfaces, which decreases traction during the first rain. Heavier winter rains, on the other hand, clear away the grime and reveal new rock surface and, for a short period of time, increase friction.

Lastly, recent studies are concerned with simulation of tire-pavement interaction by advanced computer software. Computer programs can predict when a road is likely to become slippery before crashes occur, based on information provided by the driver, including tire pressure, flexibility of the rubber on the tires, the depth of the water on the road, vehicle speed, and the grade or roughness of the stones. Laboratory stone testing and computer modeling enable engineers to select stones that will last longer in the initial road construction work.

CONCLUSION

Road grip is one of the most important aspects to keeping drivers safe on the roads of the countryside, as well as on the city streets. As we have seen in this paper, skid resistance is not a static property; it is a dynamic phenomenon that depends on the rubber tires, road stones, water, speed and weather conditions. Both micro and macro characteristics of stones are important for high friction; the stones need to have surface texture to have good adhesion to the tire rubber while the spaces between stones need to be large enough for rainwater to run off. Heavy traffic and natural weathering constantly degrade road surfaces over time, but measurement devices and computer simulations are now available to enable engineers to be effective in monitoring road conditions. Road authorities can effectively ensure that road surfaces stay grip and shorten stopping distances and keep drivers safe in all weather conditions by choosing materials that last, and maintaining asphalt surfaces proactively.

4. REFERENCES

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