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Automatic Detection, Estimation and Filling of Pothole

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Abstract

In secondary Indian roads, one often encounters potholes, which can be either dry or water-filled. Accordingly, to ensure safe driving, it is imperative to detect potholes and estimate their depths in either condition. In this paper, we develop a physics-based geometric framework, where such detection and depth-estimation can be accomplished using suitable

Here we consider diminishing resolution with increasing distance from the camera. Moreover, we design and fabricate a Semi-Automated Robot, which will discharge the required amount on concrete quantity, which is needed for the detected pothole, and to do the leveling process on the discharged concrete, and hence the pothole on the road filled completely.

In this experiment, we are also providing manual control of the robot; if the user does not want to use the automatic, then he can monitor using an android application which has all control of robot applications, like forwarding, backward, left, right, roll, fill.

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Keywords - *IR sensor, Slider crank mechanism, Levelling, Semi-automated robot.*

I. INTRODUCTION

Roads make a crucial contribution to economic development and bring important social benefits. They are of vital importance in order to make a nation grow and develop. Roads open up more areas and stimulate economic and social development. For those reasons, road infrastructure is the most important of all public assets. However, due to repeated loading and weathering on roads, a pothole may be caused, affecting human life very badly. A pothole is a structural failure in a road surface, caused by failure primarily in asphalt pavement due to the presence of water in the underlying soil structure and the presence of traffic passing over the affected area.

So, our project is to make a robot that helps society in promoting road safety and reduces the difficulties in detecting the pothole, and also reduces the usage of human power and hence saves time. We designed a Semi-Automatic Robot that will detect the pothole on the road and will discharge the required amount of concrete to fill the pothole and to do a leveling process on the discharged concrete using the slider. Therefore, the pothole on the road (Fig.1 Pothole) may be filled completely, and hence the accidents that occur due to the pothole may be reduced.

Fig:1 PotHole

- The pothole would be in pancake pavement, flexible base, or rigid composite base. Pavement areas adjacent to the pothole might be asphalt.
- An operational requirement was that the system is productive and places as much material per day as possible, with less labor and at a lower cost.
- The overall design of the system and many of the engineering decisions depend on calculated operational and maintenance costs. There are many sources of information for determining the cost of various patching operations.
- The primary economic drivers include the cost of materials, labor rates, the productivity of patching operations, costs of delays, and patch lifetimes. No single source was found that could bring all these costs into a single comparison. For this reason, we developed a productivity model to analyze how pothole patching costs are related and used it as a tool to evaluate the impact of some engineering decisions on final patch cost.
- One can look at pothole repair costs daily, seasonal, or ready basis, but that only tells part of the story. To perform a fair cost comparison of different approaches, it is perhaps best to look at the cost of making a single repair and assume equivalent patch lifetimes. When field data are available on actual lifetimes and other cost variables, the basic comparison can be adjusted.

II. LITERATURE SURVEY

Before starting this project, it is important to research existing machines and the technologies used in them. This will help us understand any existing problems and try to find solutions for these problems in such a way that it can be implemented in our project. Going through the literature also helps us understand the practical outcomes of the project and how to attain the required outcomes.

[1] Nevertheless, vast developing markets, such as India, are yet to benefit adequately from such advances because certain specific concerns remain unaddressed. For example, in countries such as India, one often encounters secondary roads dotted with potholes, which can get filled with water during monsoon. Detecting potholes and estimating their depth, especially when water is filled with bare yes while driving at night or in low light conditions, places an undue burden on the driver. In this paper, we provide the theoretical underpinnings for filling this gap by proposing a laser-based system. Specifically, we present a physics-based geometric analysis of the problem and validate it experimentally (in a scaled-down setup). Several attempts have been made at addressing related concerns. For instance, the Pothole Patrol system proposed by Eriksson et al. uses accelerometer data and GPS sensors to identify potholes and other irregularities on the road surface

[2] Men propose a similar kind of pothole detection system that uses Android smartphones with accelerometers is et al.

[3] Rode et al. use accelerometers and Wi-Fi-enabled vehicles for pothole detection and warning system.

[4] Shonil developed an FPGA based image processing system for pothole detection

[5] However, these frameworks have been developed generally with high-quality roads in view and are limited only to the detection of potholes. Hence itis imperative that such potholes are not only detected, but their depths are also estimated in both dry and water-filled conditions. In this backdrop, we propose a physics-based geometric approach for detection and depth estimation.

III. EXISTING SYSTEM

In the existing system, the pothole is detected using the accelerometer sensor in a smartphone. This system is not automotive in nature. The complaints, if needed to be posted or to be informed to any governmental authority it will be done only with human intervention. This process may not provide complete efficiency as many people may ignore the issue and not post them. Even if people send the complaint to an admin, many pothole images may be repeated, and thus it may cause huge confusion. In this case, an optimized way to collect frequent places that are being affected by potholes. Though pothole is being detected, many factors lead to life disorders such as accidents due to obstacles. This cannot be avoided in the existing system.

A. Disadvantages of Existing System

- GSM technology has been used, which causes a delay in message delivery.
- It is a paid message service.
- The severity is less estimated.
- It is exceptionally costly in nature.
- It cannot be connected to the working class level

IV. PROPOSED SYSTEM

The main objective of the project is to design and fabricate a Semi-Automated Robot, which will detect the pothole on the road and will discharge the required amount of concrete quantity, which is needed for the detected pothole and to do the leveling process on the discharged concrete and hence the pothole on the road filled completely.

The power source for the robot is switched ON and allows the robot to move on the road. The Infra-red sensor on the front of the robot is allowed to sense the surface of the road; if the pothole will be detected, the sensor sends the signals to the microcontroller, and the controller suddenly stops the movement of the robot near the pothole and allows to discharge the required concrete needed for the detected pothole. Then the pothole is leveled by the slider-crank mechanism.

A. Advantages of the Proposed System

- Accidents due to potholes can be avoided.
- It not only detects the potholes, but it also has a feature to fill the potholes.
- Uses less time to fill the potholes.
- Reduces labor work.
- Efficient data transmission**.**
- Power consumption is minimized.

V. SYSTEM IMPLEMENTATION

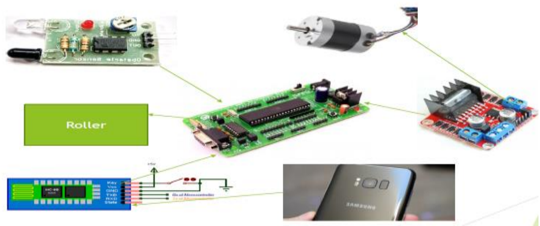

Fig:2 Implementation Diagram

A. Detection and Depth Estimation

We consider an ultrasonic sensor arrangement mounted on the vehicle to sense the presence of a pothole. The 30 cm figure is considering as the example of our project to estimate and detection of the pothole, which is commonly available in most roadside that pothole causes road accidents in most of the cases.

The main objective of our project is to give a live or demo example concerning the following diameters of the potholes. For example, we take a pothole with a 30cm width and 30cm in length, and 30cm depth. In this case, we have to try to repair such pothole with the help of detection and estimation technology of the and sensor which or mounted on the robot that will help to find the potholes and gives the information to the potholes repairs team with the appropriate information and the estimation of the required amount of the materials and the location information of the potholes by using the technologies. The robot may come to the two options manual and automatic option. In the manual, we will try to use the remote controller with an appropriate distance, and another option is for free running the robot for detecting the pothole and giving information to the pothole repairs team for the further process at the location details. Moreover, potholes could be located even in cases where no lane markings were detected.

B. Filling

The prototype filling system has been designed to be automatically controlled on a vehicle. Some of the commercial systems we evaluated showed promise, but none offered the required features for this task. The testing program clearly demonstrates that this design achieves very high productivity rates, with a very simple approach having controls ideally suited to our automation needs. They can simultaneously control the aggregate feed rate, emulsion flow rate, temperature, aggregate coverage, and fill. This is the surest way of achieving the most consistent patch performance.

VI. MODULES DESCRIPTION

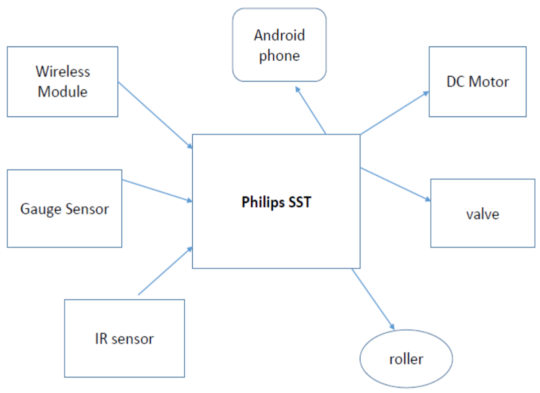

Fig:3 Block Diagram

A. Philips SST (AT89C51)

The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and erasable read-only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer that provides a highly-flexible and cost-effective solution to many embedded control applications.

B. Infrared Sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes; an infrared sensor can detect that. The emitter is simply an IR LED (Light Emitting Diode), and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages change in proportion to the magnitude of the IR light received.

C. DC Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems.

A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of the current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in the propulsion of electric vehicles, elevators, and hoists, and in drives for steel rolling mills. The advent of power electronics has replaced DC motors with AC motors possible in many applications.

In our project 4 DC motors where used to drive the robot to the certain place where it should dump the concrete and level it.

D. Gauge Sensor

Gauge pressure uses atmospheric pressure as its reference pressure and is measured relative to current barometric pressure. Since gauge pressure uses atmospheric pressure as a reference and atmospheric pressure constantly changes due to weather conditions and altitude, gauge pressure is used when applications require measurement or process to overcome atmospheric pressure to perform the desired function.

A gauge sensor should be used when measuring or monitoring pressure where the process is influenced by a change in atmospheric pressure.

Gauge sensors contain a single pressure port on the process side, and ambient pressure is applied through to the back of the sensing element via a vent.
Here gauge sensors are used to dump the required amount of concrete to fill the pothole.

E. Wireless Module

Wireless communication, or sometimes simply wireless, is the transfer of information or power between two or more points that are not connected by an electrical conductor. The most common wireless technologies use radio waves. With radio waves, distances can be short, such as a few meters for Bluetooth or as far as millions of kilometers for deep-space radio communications. It encompasses various types of fixed, mobile, and portable applications, including two-way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking. Other examples of applications of. Somewhat less common methods of achieving wireless communications include the use of other electromagnetic wireless technologies, such as light, magnetic, or electric fields, or the use of sound.

F. Roller

This is used to finish the leveling process after the concrete has been deployed on the pothole so that it makes the road smooth and to maintain the easy moving of the vehicle

G. Valve

A valve is a device that regulates, directs, or controls the flow of a fluid (gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing various passageways. Valves are technically fittings but are usually discussed as a separate category. In an open valve, fluid flows in a direction from higher pressure to lower pressure.

VII. EXPERIMENTAL RESULTS

The working of our proposed system was tested in a simulated environment in which the demo model is created, which consists of artificial potholes.
This was carried in two parts

- Detection of the pothole was initially observed and sent to the respective blocks to inform a pothole present.
- After the pothole is detected, it initiates the system to drop the required amount of concrete.
- This process was successfully carried out. This is an initial prototype this can be successfully used in the roads to fill out the potholes.

VIII. CONCLUSION

Thus, research was done regarding this project on various sources of literature. The many methodologies were studied, and this information has helped to complete the project successfully. Thus, the design calculations for the selection of motor were done. These calculations were done keeping in mind the dimensional restrictions for this project, along with economic views. The values are well within the limit, and the design is safe and accurate. Thus, the part drawing was done using Solid Works modeling software. Based on this design, the design calculations were done, and the machine is kept within these dimensions. The complete layout of the system is also shown. Thus, the process sheet has been illustrated by tabulating all the process took place during the design and fabrication of Pothole detection and leveling robot. The tables also contain the details about the controller used along with their dimensions. Thus, the robot's control and the leveling operations programming is done in the Arduino portal using basic C language. Therefore, our Semi-Automated Robot helps the society in promoting the road safety and reduce the difficulties in detecting the pothole and also reduce the usage of human power and hence saves time. Therefore, by filling the pothole, accidents that occur on the road may be reduced. The project is successfully completed and tested. All the specified requirements were fulfilled upon completion of the project.

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