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Automatic Pothole Filling Machine

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Abstract -Potholes are encountered quite frequently in paved surfaces, such as, roads, highways,driveways, parking lots, and any paved surfaces which experience wear to constant vehiculartravel, temperature, weather, and the like. The conventional techniques for road surface and pothole repair necessitate a big amount of manual activity and are sort of labour-intensive.Typically, one or two operators observe the pothole to be refilled and direct the driving force of the vehicle to position the vehicle and thereafter manually position a dispenser above the pothole, Separate tampers and/or tamping equipment is additionally typically utilized. This paper presents an attempt to design and build a prototype of an automated road repair vehicle called the Automatic Pothole Filling Machine (APFM). The APFM is capable of automatically detecting and filling potholes on road surfaces without operator assistance. An easy-to-construct mechanical means of pothole detection was employed to reduce the back costs and complexity that have so far been theprimary disadvantage of automated road repair vehicles.

Key Words:potholes, Automatic Pothole Filling Machine (APFM), paved surfaces

1. INTRODUCTION

Vehicular traffic has been quickly growing over the recent years with more privately owned vehicles taking to the streets each day. Today, trucks weigh significantly more than ever before and are capable of carrying much larger haul. The situation is further exacerbated by the decline of railroads. These factors in conjunction with bad weather result in a major challenge that transportation section throughout the country face – road damage in the form of potholes. Potholes are not only the cause of significant impairement to vehicle suspension systems but may, in severe cases, result in serious accidents and everlasting injury. Year-round pothole repairs are also a major reason for the exhaution of state funds. The United States alone spends billions of dollars every year on pavement maintenance. Thus there is an impending need for pothole repair techniques that are cost effective as well as everlasting.

The most notable aspects of the development of human civilizations are the advent of roads. Roads have allowed humans to exchange goods and services and have provided civilizations with the necessary mobility required for living. The problem of maintenance of the roads has been an issue to this date and time has progressed this problem has only become more complex. “A pothole is any walkway defect involving the surface or the surface and base, to the extent that it causes significant noticeable bang on vehicle tires and vehicle handling. All potholes are the result of the interaction of water and traffic on walkway.

The roads have become highly complex and road networks spanning larger and larger areas.Invention of the engines, vehicle and motorized equipment’s boosted human civilizationexponentially, but with it the matter of road maintenance became extremely vital to minimizethe threat of vehicular accidents. One specific problem of road maintenance is because of thegradual appearance of slight cavities on pavements and roads due to natural processes. Thesecavities and depressions are potholes which have been a major and consistent problem for maintenance of roads. They are the results of wear and tear and weather cycle, etc. In the modern age potholes generally tend to be bowl-shaped openings in the road and their depths can go up to and 10 inches and even more in the most severely ignored cases. Today roads have a concrete base and a top layer made up of asphalt and the top layer of asphalt can wear quickly exposing the concrete base.

This process fastens due to rain-water, pipe line damages, etc. accumulating in these bowl-shaped cavities and may result into big potholes that may eventually cause damage and severe car accidents. Negligence of maintenance can lead to numerous damages that ranges from vehicle damages to the loss of human lives. Since this is an inevitable problem and it is difficult to tackle permanently, there is a great requirement of having a classification scheme that would prioritize potholes as their aim of destructiveness. Once given the priority to the repair and maintenance of the potholes it can be easy to tackle and destroy completely if the problem is treated before it gets too complex.

2. Problem Definition

Driving through a pothole on the road every day is tedious of any one and a great troll on their vehicle. Some of the more common damage is a flat tire or damage to your tires, bent or damaged rims, suspension damage, steering damage and even damage to the body of the car.

In today's world there is lot of people suffering through the back pain, lower back pain or other body parts paining which is somewhere directly or indirectly related to the jerks caused on the body while travelling on an uneven surface. There are cases of complete lower back damage caused due the very high bump effect caused due to a pothole.

Hundreds of millions of dollars are spent annually on pothole repair, at the further cost of work zone casualties, loss of productivity, damaged goods and vehicles, and the accelerated deterioration of our road system. This few months‟ efforts are for complete atomization of repair procedure. The goals were set very high. An automatically made permanent repair was the ultimate goal target. The system was to use no laborers to reduce the cost of making repairs. Speedy and yet quality repairs were required to be made in nearly all-weather conditions.

3. Literature Review

Sr. No.	Name of Article	Name of Authors	Publication Details	Remarks
1	Pothole patching: review on materials and methods	MATTHEW SAINZ	International Association for Performing Arts And Research	High skilled labour requirement
2	Future road repair technology	DAHIR SEMENOV	Federation of Indian Chambers of Commerce and Industry (FICCI)	Cost of process and preparation is high
3	Liquid Pothole Filler	Western reserve university	Popular Science Magazine	Not suitable for large
4	Design and fabrication of pothole detection and levelling	ROHIT VL YOGESH R	MyGov: Innovate	Semi-automatic.

Outcome of the literature review

The conclusion for the literature review indicates that there is much possibility for this technology to develop the existing system requires high skilled workers, cost of the process is high, not suitable to large holes and they are mostly semi-automatic. The project of our will be fully automatic and will not require skilled worker for the operation. the sensors in our system allows to fill considerably large holes than the existing system.

4. Methodology

Current research on pothole repair is often divided into two broad categories.

1) Repair Materials –

Typically the varied kinds of mixes that are used for pothole patching are hot-mixes, cold-mixes, heated cold-mixes, and recycled mixes. Hot-mixes from an asphalt plant are the only material for patching potholes. However, the use of hot-mixes is restricted because of their unavailability within the winter season as asphalt plants are closed at the time. Also, hot-mixes don't perform satisfactorily when utilized in wet potholes.

Most agencies make use of 1 or more of three kinds of cold asphalt mixes that are available to them – cold-mixes produced by local asphalt plants using locally available aggregate and binder, cold-mixes produced according to agency specifications including acceptable kinds of aggregate and asphalt, and proprietary cold-mixes that use specifically formulated binders . The latter two kinds of cold-mixes got to be checked for the compatibility of the binder and thus the mixture. Proprietary cold-mixes include high-performance mixes with adhesive agents and anti-stripping. While being costlier , these high-performance mixes significantly increase the service lifetime of the repair and are a much better alternative for pothole repair.

2) Repair Techniques – Four kinds of repair techniques are commonly utilized for pothole patching as described in.

a) Throw-and-roll –

This method consists of placing the patching material into the pothole then compacting the patch using truck tires. The compacted patch should have a crown between 3 mm and 6 mm.

b) Semi-permanent –

This method consists of removing the water and debris from the pothole. The edges of the patch area are squared-up and thus the mixture is placed into the pothole. This is often followed by compacting the mixture.

c) Spray Injection –

This method consists of blowing water and debris from the pothole. The edges and bottom of the pothole are then sprayed with a tack coat of binder. Next, aggregate is simultaneously premixed with heated asphalt emulsion and sprayed into the pothole, and eventually the patched area is roofed with a layer of aggregate. The spray injection method doesn't require compacting.

d) Edge Seal –

Like throw-and-roll, this method consists of placing the mixture within the pothole and compacting it using truck tires. Once the patch has dried, a ribbon of asphaltic tack material is placed on the patch edge and a layer of sand is placed on the tack material.

5. Planning

STAGE 1: - To design a machine with sensors, filler materials, roller and Arduino circuit / Micro-Controller.

STAGE 2:- Deduction of obstacles and holes so that by seeing the sensors the vehicles can avoid the obstacles and also to detect the holes.

STAGE 3: - To fil the hole and to make the surface even and smooth for the vehicles.

STAGE 4: - To move roller on the filler and to level the road and the potholes.

6. Block Diagram

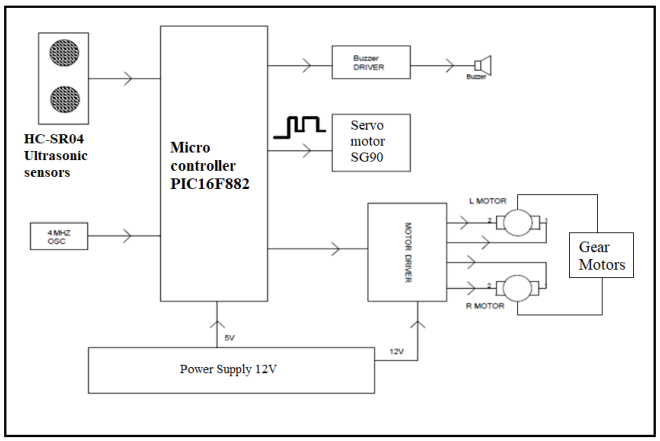


Fig: Block Diagram of Pothole Filling System

Main micro controller unit:-

A microcontroller is a computer present in a single integrated circuit which is dedicated to perform one task and execute one specific application. It contains memory, programmable input/output peripherals as well a processor.

Ultrasonic sensor interface :-

An Ultrasonic Sensor is a device that measures distance to an object using Sound Waves. It works by sending out a sound wave at ultrasonic frequency and waits for it to bounce back from the object.

Servo motor interface :-

A servo motor is an electric device used for precise control of angular rotation. It is used in applications that demand precise control over motion, like in case of control of a robotic arm. The rotation angle of the servo motor is controlled by applying a PWM signal to it.

12 Volt Dc Buzzer :-

A buzzer or beeper is an audio signaling device; DC voltage is given to small electronic oscillator circuit inside the buzzer, Output of the circuit drives piezoelectric disk that produces mechanical vibration as voltage is applied to it

Crystal oscillator :-

A crystal oscillator is an electronic circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters/receivers.

GEAR MOTOR:-

The 30 RPM BO Motor Plastic Gear Motor – BO series straight motor gives good torque and rpm at lower operating voltages, which is the biggest advantage of this motors. Small shaft with matching wheels gives an optimized design for your application or robot. Mounting holes on the body & light weight makes it suitable for in-circuit placement. This motor can be used with 69mm Diameter Wheel for Plastic Gear Motors and 87mm Diameter Multipurpose Wheel for Plastic Gear Motors. Low-cost geared DC Motor. It is an alternative to our metal gear DC motors. It comes with an operating voltage of 3-12V and is perfect for building small and medium robots and available with 60 and 150 RPM.

7. Hardware and Software used:

Hardware-

1. Ultra sound based Distance sensor for Hole detection.(HC-SRO4 Sensor).
2. One SPDT Relay based switching output for external Hole Filling Mechanism operation.
3. 12V Buzzer (alarm) – For Sensor Detection audible indication.
4. Relay output - 5A rated changeover contacts.
5. Stepper Motor Based Robot Precise Movement.
6. Dual (2x) Motor Driver for Robot Controlling.
7. Motor Driver output – 600 MA rated Per Channel.

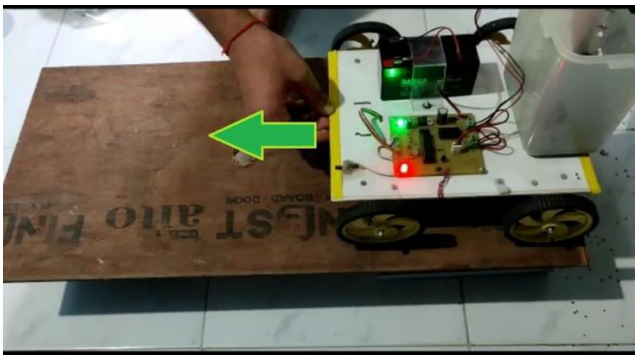
8. Power on LED Indication Relay on / off LED Indication.
9. Operating voltage – 12 to 15V DC.
10. Operating current – 500ma (Approx.).
11. Diode protection for reverse polarity connection of DC supply to the PCB.
12. Onboard regulator for regulated supply to the kit.
13. PIC Microcontroller based design for greater flexibility. (PIC16F882).

Software

1. Arduino IDE (open source soft.)
2. Eagle
3. EasyEDA (pcb design)

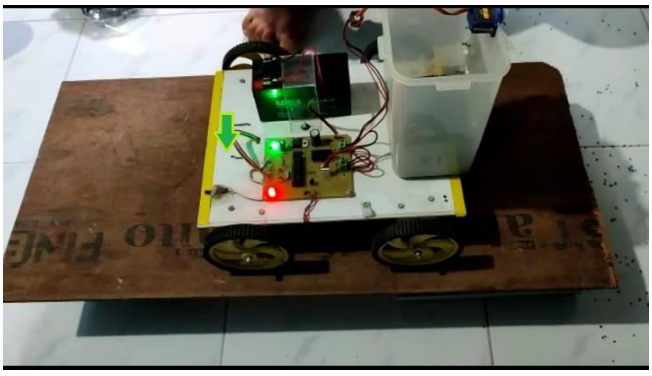
8. Results

Step-1: Moving Forward



When the machine is in auto mode, the machine will automatically move forward with the help of gear motor. It will move forward until it detects the path holeusing ultrasonic sensor.

Step-2: Detection of Pothole



The path hole will be detected with the help of ultrasonic sensor. The sensors will continuously transmit an ultrasonic wave form the transmitter and then wave will travel in air and reflect back to the sensor's receiver. If there is any disturbance or differences between transmitted and received wave (i.e. if pulse width is more than 25ms), the microcontroller will detect the Pothole and the machine will stop.

Step-3: Calculation of Distance to dump the material

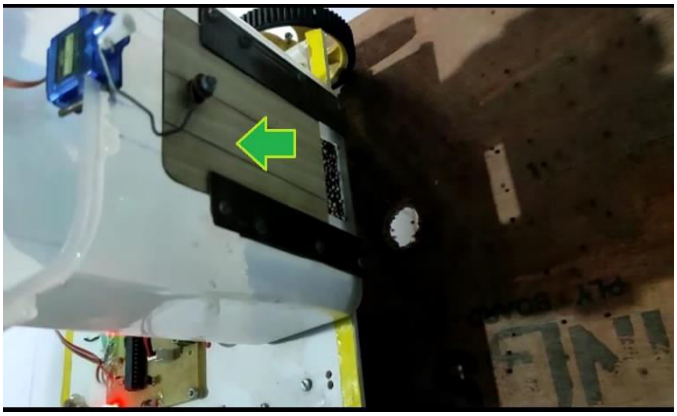
The distance between the point of maximum depth and the filler valve is required to position the IPRV for the filling operations. This is calculated using the variables-

Number of counts per wheel rotation = 64

Distance moved by the IPRV in one-wheel rotation = 99.5 cm

The number of counts/cm = 64/99.5 = 0.6432 counts/cm

Step-4:Servo motor working while dumping material



The output shaft of the servomotor is capable of traveling somewhere around 180 degree. A 1.5ms pulse is provided to servomotor which makes the motor turn 90-degree position, which lifts the slat and thus allows material to fall on detected pothole.

Step-5: Rechecking whether the hole is filled

After dumping the material in pothole, the model will again move backward and will check whether the hole is filled completely in the same way as it did in step 2. If it is not filled completely it will again repeat step 3 and 4. Or else it will move forward.

9. Conclusion

There were a lot of things to consider for making this pothole filling technology to be viable in countries where rules for lane driving are not followed will be a challenge for this technology.

In today's world there are lot of people suffering through the back pain, lower back pain or other body parts paining which is somewhere directly or indirectly related to the jerks this product can help in reducing this number to a greater extent Some dependencies must be adjusted to get more accurate model with respect to the field.

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BIOGRAPHIES (Optional not mandatory)

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The Author has a teaching experience of 11 Year in reputed organization.

His area of interest is Computer Communication, Wireless Communication, Analog Circuits and Digital Circuits.