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Road Maintenance and Restoration using Intelligent Pothole Filler

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ABSTRACT: Poor maintenance of roads lead to formation of pot holes. Potholes are the main reasons for most of the road accidents. Numerous lives are lost because of the rough roads and their poor conditions due to pits formed in them. Timely and regular check on the roads is needed to avoid formation of such life-threatening cavities. These holes can be a grave problem especially during the monsoons. This process can be very time consuming as well as expensive. The paper proposes a method in which a bot detects these holes and fills them up with an appropriate material. The bot also avoids other obstacles in its way. IR sensors are used to determine the actual pits which are deeper than few centimetres. Once the hole gets detected, it will get filled with appropriate materials through a funnel like structure thus providing an efficient and economic method for road maintenance.

KEYWORDS: Arduino Uno R3, IR Sensors, Motor Drivers, Servo Motor.

I. INTRODUCTION

Majority of the Indian population uses the roads as a mean of transport. With the ever-increasing vehicles, it has led to overcrowding and traffic jam. Roads are salient contributors to the lucrative and communal developments of any nation. They play a significant role in a nation's growth. They are used for carrying goods from one place to another and so act as a stimulus for economic and social development. Thus, the framework of roads is pivotal of all public virtues. These roads must be maintained so as to ensure safe paths for the transporters. Due to weather conditions and loading, the roads get ruptured leading to formation of potholes in them. During rainy seasons these potholes may even be invisible to the human eyes. They usually get accumulated with muddy water and drivers may not be able to dodge them leading to fatal incidents. Negligence in maintaining the roads lead to a lot of accidents. As per Global Safety Report by World Health Organisation (WHO), 2,00,000 plus deaths are caused due to accidents taking place on roads. However, these deaths may be due to reasons such as drinking and driving, over speeding, breaking traffic rules, pot holes [1]. Due to all the above-mentioned reasons, it is necessary to have good quality of roads which need suitable and punctual quality checks. Involving group of workers each time maintenance is required will be very tedious for the people as well as incur labour cost. Thus, a cost-effective solution is needed to solve this serious issue.

The Pothole Filler is thus a smart, intuitive repair vehicle that detects the holes and automatically starts filling them until the road becomes even. This paper provides a commercial and well-grounded solution for pot hole filling process. The main objective of this paper is to provide a solution so as to solve serious real-time issues faced by the society.

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II. BLOCK DIAGRAM AND WORKING

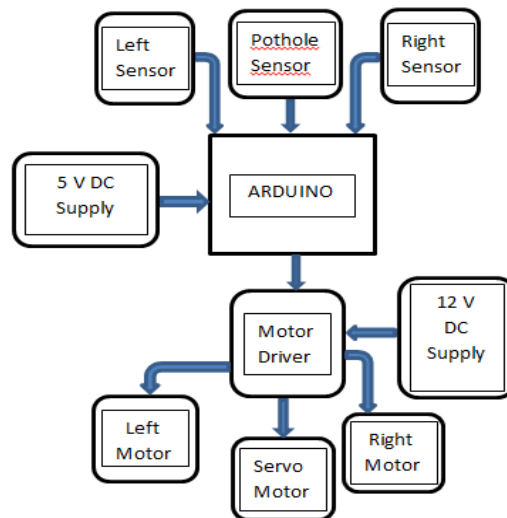


Fig. 1 Block Diagram

The block diagram comprises of the following units:

A) **Arduino:**

It is supplied with 5V DC power supply. It transmits pulses to each of the three sensors which are left, right and pothole (mounted on lower side of the BOT). It also controls signals transmitted to the Driver unit which in turn supplies adequate current to the other three motors. Arduino is used to develop objects that can be interactive with each other. It takes inputs from variety of sensors and controls a variety of outputs such as lights, motors, etc. Arduino projects are stand-alone, or they are able to communicate with software which runs on your computer. The boards can either be bought as pre-assembled or can be manually assembled; the open-source IDE can be downloaded for free. [2]

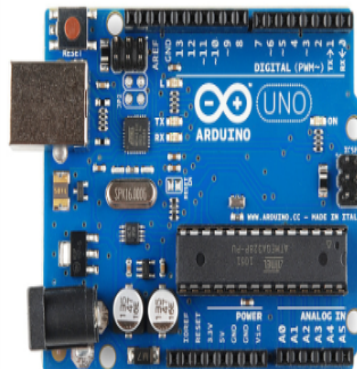


Fig. 2 Arduino

B) **Left and right Ultrasonic Sensors:**

The Ultrasonic sensors acquire pulses of constant speed from the Arduino and emits ultrasonic sound waves in space. When these sensors are obstructed by any object, these sound waves get collide on the object's surface,

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reflect back and are received at the sensor's receiver. This received signal is sent back to the Arduino after being converted into electrical pulses by the sensors. The Arduino measures the distance of the obstacle from the sensors as the speed of the pulses is constant by calculating the time required for pulses to return that is directly proportional to the distance. [3]



Fig. 3 Ultrasonic Sensor

C) Pothole Sensor:

It is also an ultrasonic sensor but mounted on the lower side of chassis. It is used for detecting the potholes which are deeper than 2 centimetres.

D) Motor Driver Unit:

It controls the DC motor movements, isolates the arduino from the DC motors and from getting damaged by heavy motor current. It also supplies enough current to the servo motor which gives precise angular rotations and controls the flipping mechanism that fills up the pits with suitable material in the funnel. L293D motor driver is used for this purpose.[4]

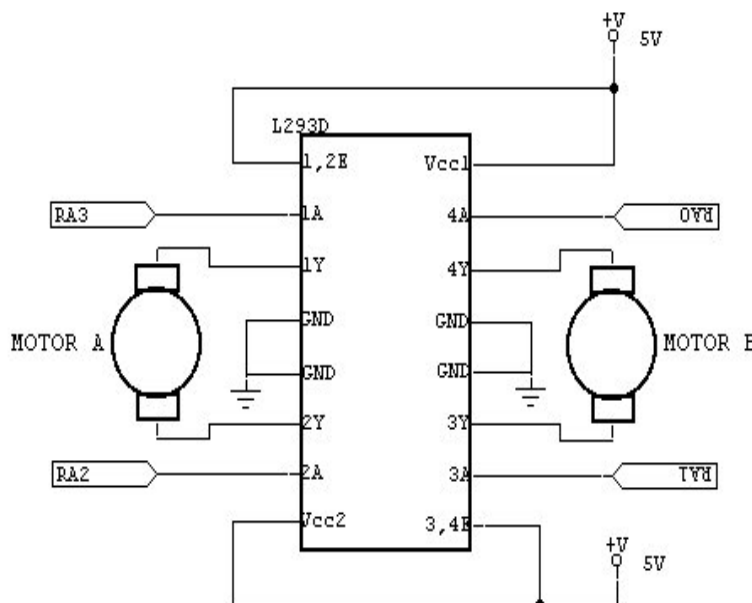


Fig. 4 Motor Driver Circuit

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E) Power Supply:

+5 Volts DC supply is required for the arduino. 12 Volts DC for DC motors and +5 Volts external power supply for servo motor as well.

F) Servo Motor:



Fig. 5 Servo Motor

Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees(90 in each direction) and works just like the standard kinds but smaller.

Arduino sends out trigger pulse to the left sensor, right sensor, pothole sensor through pins D7, D8, D9 respectively. It receives echo signals from the same pins. The DC motor movements are controlled by Arduino using IC L293D. Pins D2 and D3 generate controlling signals for left motor whereas pins D4, D5 generate the same for the right motor. The left and right H-bridges are attached 2 motors in parallel each. +5V is enough for Servo motor but it needs high current, hence external power supply with higher current capacity is used as power supply for the servo motor. This is done by +9V DC battery IC 7805 (voltage regulator).

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III.PROGRAM FLOW

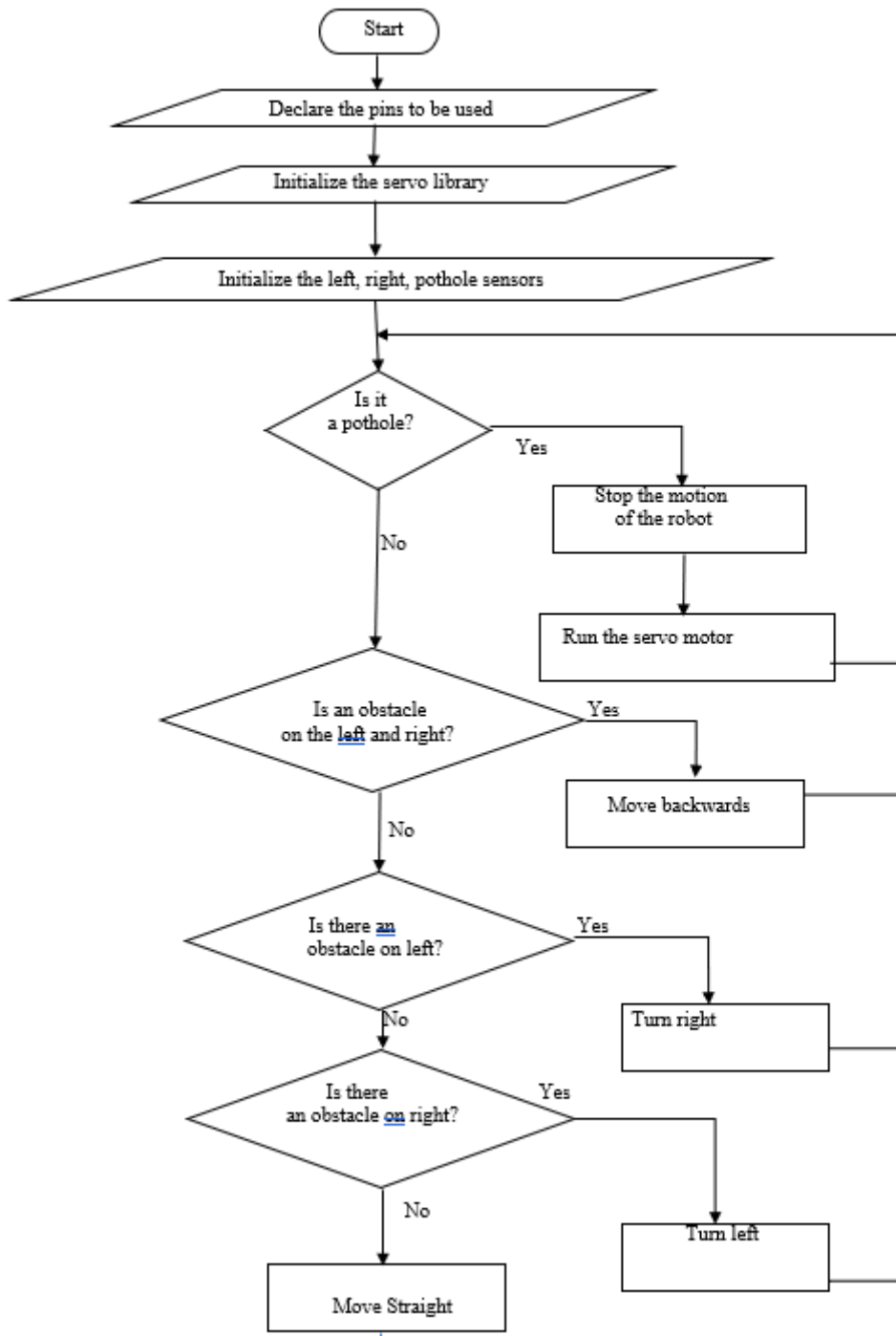


Fig. 6 Flowchart

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As per flowchart, the bot acts as an obstacle avoider so that it does not collide with any barriers in its path. It turns its directions on basis of where the obstacle is present. This decision is taken by arduino which is pre-programmed. The sensors below will detect the pothole and once pothole is detected, the bot will stop and start the filling mechanism. The hole is detected by arduino as it receives the echo signals from the sensors. These signals help to determine the distance between the sensor and the surface. Thus, if the distance of the hole's bottom is more than 2 centimeters, it is considered as a cavity which needs to be fixed. A funnel like structure is attached on the BOT's frontal side. This funnel is filled with cement, soil, etc. On receiving commands from arduino, the Servo motor gives angular rotations. A sturdy, flat piece is joined to servo motor which will control the filling up process. This mechanism allows a controlled way of filling up the cavity. Once the cavity is filled, the sensor senses that the hole is now leveled up with the road and the BOT then continues moving forward in search of other anomalies on roads in need of repair.

IV. RESULTS



Fig 7 BOT in motion when no hole detected

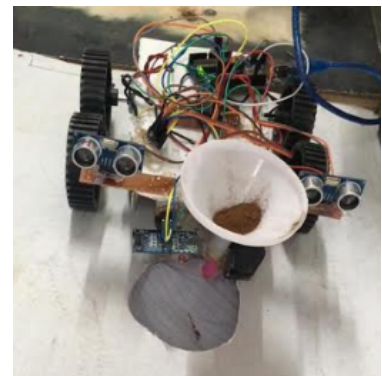


Fig 8 Hole detected so BOT stops

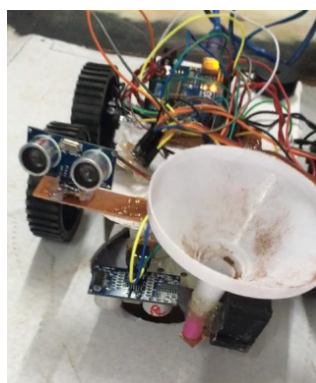


Fig. 9 BOT moves ahead after filling the hole

V. CONCLUSION

Thus we conclude that the autobot is capable of surfing freely on the tracks and filling the potholes. Also because of its automation the man power required for this task is eliminated. It also proves to be an efficient way of filling the potholes in less amount of time. So we have taken a step forward towards betterment of society.

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VLFUTURE SCOPE

- A) The pothole filler is basically a prototype autobot having its own limitations.
- B) The prototype can be further enhanced with more funds.
- C) The motors with more torque and rpm can be used for swift surfing of the bots.
- D) A roller can be attached to the autobot to level the material filled in pothole.
- E) The autobot can be connected to the GPS and thus the current location of the autobot can be traced.
- F) Cameras can also be incorporated to obtain live footage of the working site.

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