WATER FILLED POTHOLE DEPTH DETECTION.

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ABSTRACT

The paper proposes a solution to the pothole that is being causing accidents and various damages to the vehicle and the human life ,here we are helping out the users to identify the depth of the pothole in advance and the system showcases the depth of the pothole thereby alerts the driver whether to pass through the pothole or to skip the pothole by redirecting the vehicle ,the model also gives the 3D image of the pothole thereby estimating the depth of the pothole using the PYTHON programming in Visual studio code,by using ultrasonic sensor with Arduino ide we are finding the depth of the dry pothole ,for water filled pothole we are using water proof ultrasonic sensor with Arduino ide to find the depth of the waterfilled pothole

Keyword: - *Pothole depth, Visual studio code, Ultrasonic sensor, Arduino ide, Python.*

1. INTRODUCTION

Potholes in road surfaces are mostly caused by water (CSIR, 2010) and regular road maintenance is vital to prevent the decaying process. An example of a road with potholes is shown in Figure 1. The manner in which a pothole forms is dependent on the type of bituminous pavement surfacing. The volume of traffic and the axle load experienced by the road are example factors that lead to fatiguing of the road surface, resulting in the formation of cracks. These cracks allow water to seep through and mix with the asphalt. When a vehicle drives over this area, this water will be expelled through the crack with some of the asphalt, and this will slowly create a cavity underneath the crack. Eventually the road surface will collapse into the cavity, resulting in a visible pothole. If regular road maintenance is neglected, the aforementioned cracks are not repaired before they cause substantial damage to the road.

For road maintenance to take place, it is obvious that the entity responsible for the road in question must know where the pothole or decaying road section is located and an automated process could assist with this. Potholes are also problematic for drivers as they can cause a lot of damage to their vehicles. Currently, there is no device/system available to drivers that would allow them to avoid potholes. There is thus a potential market for such a solution.

The first step of the solution requires developing a device that is attached to a vehicle and will continually scan the road surface. If a pothole is detected, it will alert the driver in time and enable the driver to avoid the pothole. The second key aspect of the solution is to enable the device to log the position of the pothole via GPS (Global

Positioning System). The GPS data can be uploaded via a GPRS (General Packet Radio Service) module to a network system incorporating mapping software such as Google Maps or OpenStreetMap. The data in the system can be made available to the general public as well as municipalities and road maintenance agencies. A higher awareness of the location of potholes will result in road users being more careful on certain roads or even less usage of an affected road which would reduce the additional formation of potholes. This paper focuses on the pothole detection task in the first step. The later steps will be considered in future work.

Fig-1: Pothole example

This paper discusses a method for detecting potholes (via image processing) that does not require any machine learning, but is based on an algorithmic approach that is rooted in the fundamental properties of potholes. Due to the visual nature of the approach, it is self-evident that the solution is dependent on lighting conditions, obstructions in the line of view, rain and any other factors that visually impair the ability to see potholes. The work presented is therefore limited by this aspect and so does not provide an all-encompassing solution. The next section will briefly summarize the current pothole detection literature. Thereafter, the proposed methodology will be discussed in detail. An implementation including preliminary results will be presented and a clear conclusion on the effectiveness will be drawn from the results

1.1 OVERVIEW

The potholes create the bad condition on the road especially in monsoon potholes are occur much more because of poor road .so avoiding this pothole we introduce “Pothole Detection System” which detect the potholes on the road of the particular area and display the total number of the detected potholes on the user dashboard. So user knows how much potholes on which road of the particular area and user can alert about that road as well as this count of detected pothole is published to all the users so user can complain to government to take the action immediately for potholes so it also avoid the corruption because the count is openly displayed of the particular area on the all user dashboard. Potholes plague the life of the daily commuter. Some cities make an effort to fill them, but given the ecological situation of most roads, potholes will continue to pop up or remain unfilled due to apathy or a lack of resources from the city. Even in larger cities, potholes take between two to three days to get fixed after they are reported

In the area of pothole detection, there have been many companies and enthusiasts that have worked on this problem. Our project is different from the ones we found online because we are creating a sensor that attaches to the car itself with an accompanying app. Both would be sold together as a standalone consumer product. Our goal is to create a public map that could help local governments detect potholes faster than the current self-reporting method. Our end customer would be citizens who feel their community isn’t efficient about fixing potholes and municipalities who want to more efficiently deal with the issue. As far as we can tell, the only similarity between our project and what has been done before is the detection of potholes. The crowdsourcing of information for pothole detection and standalone product are new. In this project we have used sensors water penetrating ultrasonic sensor to detect the depth of the water filled pothole and images processing technology has been used which shows the 3 D

model of the water filled pothole so based on this image the driver can assume the depth of the pothole and can take required diversion.

1.2 BASIC CONCEPTS

Overview Pothole detection system which notifies the driver to avoiding the pothole on the road by giving the warning. This pothole detection system idea is to alert the driver if pothole is detected on the way to reduce the speed of the vehicle or choose another path, to detect the pothole distance from driver which driving the vehicle. This detecting system based on image processing It is developed to process and analysis the dataset captured using the camera fix in the vehicle. It gives high efficiency and accuracy compared to the conventional method of the pothole detection on the road.

2. METHODOLOGY

When the vehicle is moving on the road, ultrasonic sensor is controlled through Arduino which is mainly used to detect the depth of the dry pothole and it shows its depth. For water filled pothole Arduino camera module OV 7670 is used which is used to capture the image and sends the captured images to the computer. Using image processing technology we would be able to convert the captured pothole image to 3-D model. So on the basis of the images we would be able to predict the depth of the pothole.

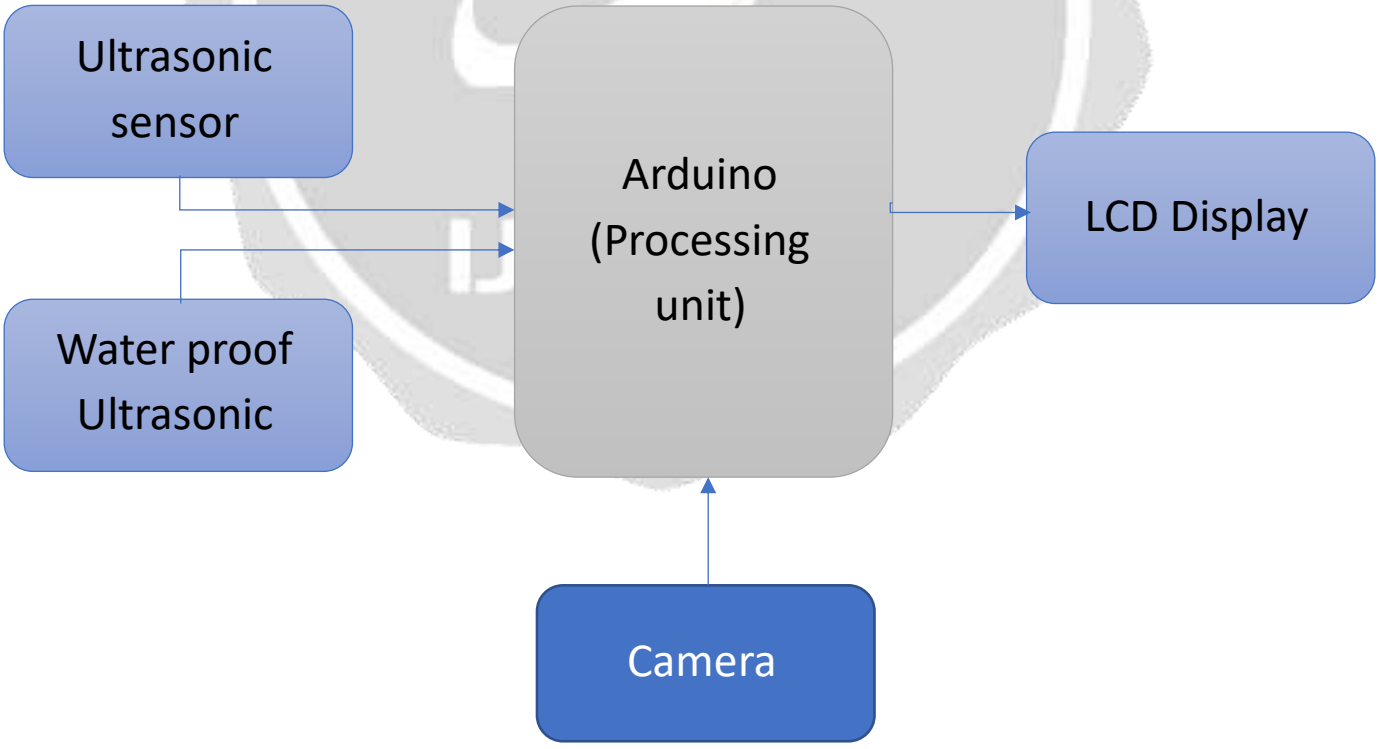

Fig-2:Methodology

3. SOFTWARE AND HARDWARE

3.1 SOFTWARE

The software that is used for the implementation are:

- Arduino IDE
- Visual Studio Code

3.1.1 Arduino IDE

The Arduino IDE is a software application used to write and upload code to Arduino boards. It is open-source and compatible with various operating systems, such as Windows, Mac OS X, and Linux. The programming languages supported by the IDE are C and C++. To use the Arduino board, it is connected to a computer via USB, where it interfaces with the Arduino development environment (IDE). The user writes the Arduino code in the IDE and then uploads it to the microcontroller, which executes the code and interacts with various inputs and outputs, including sensors, motors, and lights. Arduino boards are programmed using a C/C++ "dialect," meaning most C/C++ code will work, but not all standard libraries will be compatible. The Arduino Uno is programmed using the Arduino Software (IDE), which is an Integrated Development Environment that is common to all Arduino boards and can run both online and offline. The IDE contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

Fig -3: Arduino IDE software

3.1.2 Visual Studio Code

Visual Studio Code is a source-code editor that can be used with a variety of programming languages, including C , C# ,C++ ,Fortran , Go ,Java, JavaScript , Node.js, Python, Rust. It is based on the Electron framework, which is used to develop node.js web applications that run on the Blink Layout Engine. Visual Studio Code employs the same editor component (codenamed "Monaco") used in Azure DevOps (formerly called Visual Studio Online and Visual Studio Team Services).

Out of the box, Visual Studio Code includes basic support for most common programming languages. This basic support includes Syntax highlighting, bracket matching, code folding, and configurable snippets. Visual Studio Code also ships with IntelliSense for JavaScript, TypeScript, JSON, CSS, and HTML, as well as debugging support

for Node.js. Support for additional languages can be provided by freely available extensions on the VS Code Marketplace.

Instead of a project system, it allows users to open one or more directories, which can then be saved in workspaces for future reuse. This allows it to operate as a language-agnostic code editor for any language. It supports many programming languages and a set of features that differs per language. Unwanted files and folders can be excluded from the project tree via the settings. Many Visual Studio Code features are not exposed through menus or the user interface but can be accessed via the command palette.

Visual Studio Code can be extended via extensions, available through a central repository. This includes additions to the editor and language support. A notable feature is the ability to create extensions that add support for new languages, themes, debuggers, time travel debuggers, perform static code analysis, and add code linters using the Language Server Protocol.

3.2 HARDWARE

3.2.1 Arduino uno

The **Arduino Uno** is an open source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.[1] The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by a USB cable or a barrel connector that accepts voltages between 7 and 20 volts, such as a rectangular 9-volt battery. It is similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

The word "uno" means "one" in Italian and was chosen to mark a major redesign of the Arduino hardware and software. The Uno board was the successor of the Duemilanove release and was the 9th version in a series of USB-based Arduino boards. Version 1.0 of the Arduino IDE for the Arduino Uno board has now evolved to newer releases. The ATmega328 on the board comes preprogrammed with a bootloader that allows uploading new code to it without the use of an external hardware programmer.

While the Uno communicates using the original STK500 protocol, it differs from all preceding boards in that it does not use a FTDI USB-to-UART serial chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

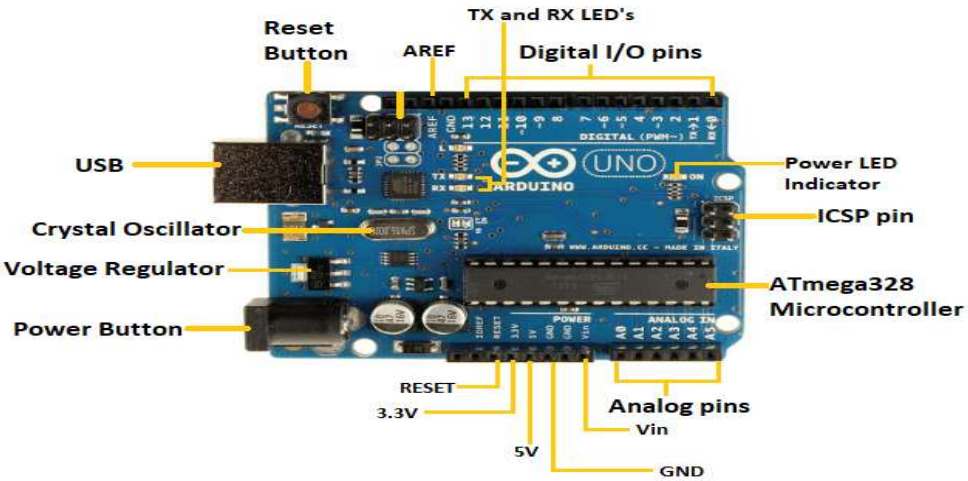

Fig-4: Arduino UNO

3.2.2 Ultrasonic sensor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

Fig-5: Ultrasonic Sensor

3.2.3 Camera OV 7670

OV7670 640X480 VGA CMOS CAMERA IMAGE SENSOR MODULE is a low-cost image sensor, DSP that can operate at a maximum of 30 fps and 640 x 480 ("VGA") resolutions, equivalent to 0.3 Megapixels.

The captured image can be pre-processed by the DSP before sending it out. This pre-processing can be configured via the Serial Camera Control Bus (SCCB). OmniVision OV7670 CMOS VGA (640×480) CAMERA-CHIP Sensor with OmniPixel technology 3.3V DC Input Voltage. working Temp. 0-50 Degree Celsius All Glass Lenses, Lens(including seat) is Magnesium Alloy material.

Focal length of lens is 3.6 mm 650 nm Bands Black FR-4 PCB, Quality Heavy Gold Plate, effectively prevent the PCB from light leak issues and prevents shadow in images 2×10 0.1″ output connector for convenient insertion into Prototype Board, Bread Board, MCU Onboard Connectors This Camera module is very powerful and easy-to-interface with 8/16/32 bit Micro-controller. OV7670 640X480 VGA CMOS CAMERA IMAGE SENSOR MODULE will provide vision to your small embedded systems and will be useful for plenty of applications in Robotics.

Fig-6 :OV 7670 Camera Module

4. IMPLEMENTATION

Recent advances in vehicular safety and driver assistance technology have greatly reduced the burden of driving. Examples include collision warning, localization, cooperative driving, and driverless vehicles, which has been enabled by vehicular communication. Yet, 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-filled, with bare eyes while driving at night or in low light condition places 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.

Fig-7: Model implemented

5. RESULTS

The following images shows that how pothole and its depth is being detected using images processing and how conversion of normal images is converted to 3 D image.

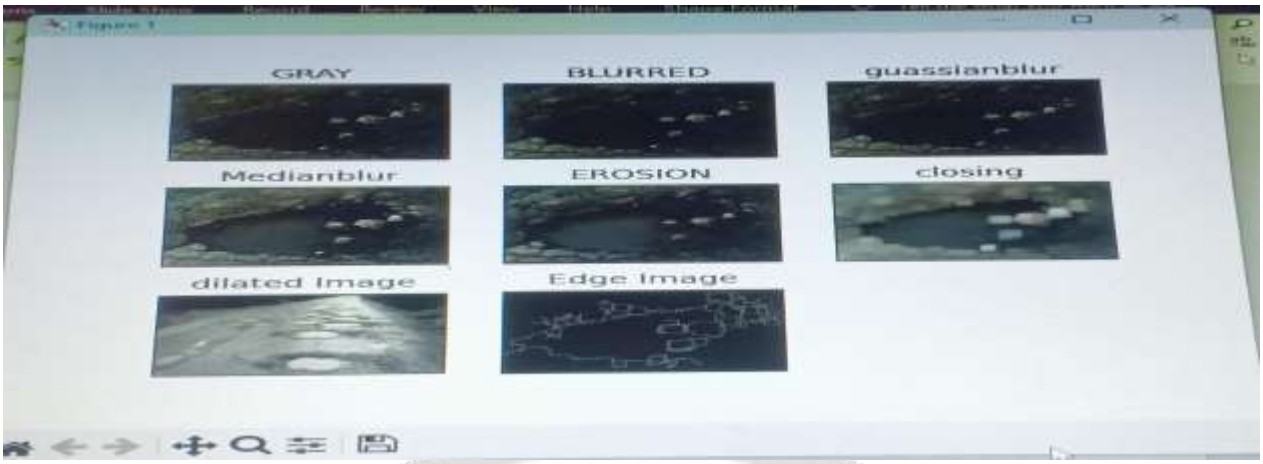

Fig-8 : Image processing result

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