ROAD SAFE ALERT SYSTEM: ENSURING VEHICLE SAFETY THROUGH DIGITAL NOTIFICATIONS DURING MANHOLE AND ROAD CONSTRUCTION DIVERSION

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ABSTRACT

The project titled "Road Safe Alert System" presents a groundbreaking solution to enhance road safety by providing real-time digital notifications to drivers during manhole and road construction diversions. This innovative system leverages cutting-edge technology, including IR sensors, servo motors, LEDs, an LCD display, and cloud-based communication via the Thing Speak server, to ensure vehicle safety and reduce road hazards.

At its core, the system employs IR sensors to detect the presence of open manholes on the road. When an open manhole is detected, a red LED indicator is activated to warn approaching vehicles, significantly reducing the risk of accidents caused by manhole hazards. Furthermore, the system utilizes a servo motor to indicate road diversions, ensuring that drivers are aware of construction or roadwork zones ahead. The system uploads the detected manhole and diversion information to the Thing Speak server, which serves as a digital notification platform. This information is displayed on an LCD screen within the vehicle, providing drivers with real-time updates about potential road hazards and diversions. The "Road Safe Alert System" not only prioritizes road safety but also demonstrates the power of technology in creating a safer and more informed driving experience for all road users.

Keyword : - *Arduino , LCD, Red LED, Manhole, Road Diversion*

1. INTRODUCTION

The "Road Safe Alert System" is an innovative project designed to enhance road safety by providing real-time digital notifications to drivers during situations like manhole placements and road construction diversions. With increasing urbanization and road infrastructure development, it's crucial to mitigate potential hazards and accidents caused by sudden road disruptions. This system aims to address these challenges by leveraging modern technology and communication networks.

Traditional methods of warning drivers about road hazards often rely on static signs or manual flagging, which may not always be effective, especially in dynamic situations like temporary road diversions or sudden manhole placements. This project proposes a smarter approach by integrating IoT (Internet of Things) devices and mobile networks to deliver instant notifications

directly to drivers' smartphones or vehicle consoles. By providing timely alerts, drivers can make informed decisions and adjust their routes or driving accordingly, reducing the risk of accidents and traffic congestion.

The system operates by deploying IoT sensors strategically along roadsides or construction sites to detect specific events such as manhole placements or road closures. These sensors are equipped with connectivity modules that transmit data to a centralized control system. When an event is detected, such as a manhole cover being opened or road construction activities beginning, the system automatically sends notifications to nearby vehicles equipped with compatible receivers. This proactive approach to road safety not only improves driver awareness but also contributes to overall traffic management and urban planning efforts.

1.1 Embedded System Implementation

An embedded system is one kind of a computer system mainly designed to perform several tasks like to access, process, and store and also control the data in various electronics-based systems. Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware. One of its most important characteristics of these systems is, it gives the o/p within the time limits. Embedded systems support to make the work more perfect and convenient. So, we frequently use embedded systems in simple and complex devices too. The applications of embedded systems mainly involve in our real life for several devices like microwave, calculators, TV remote control, home security and neighborhood traffic control systems, etc.

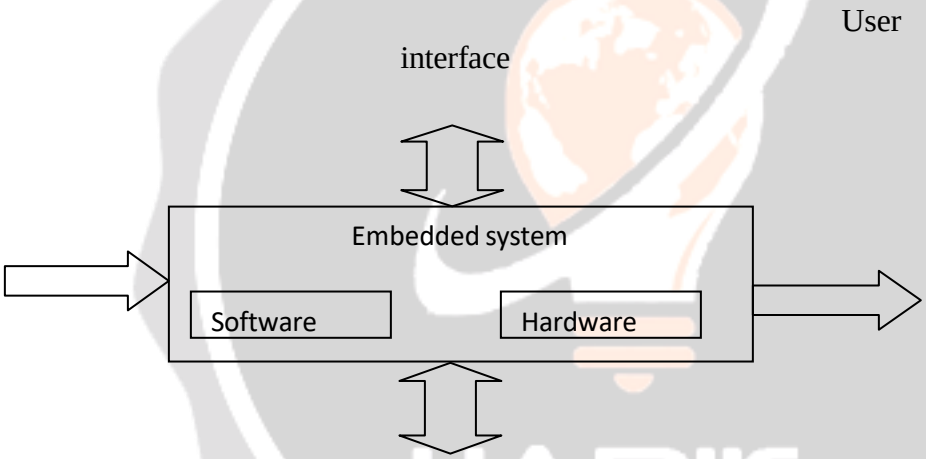

Fig-1: Overview of Embedded System

1.2 Implementation Flow

Stage 1:
Considering the problems of existing methods and giving solution to that problem by considering the basic requirements for our proposed system

Stage 2:
Considering the hardware requirement for the proposed system For this we need to select the below components:

1. Microcontroller
2. Inputs for the proposed system (ex: sensors, drivers etc...,)
3. Outputs (ex: relays, loads)

Stage 3:
After considering hardware requirements, now we need to check out the software requirements. Based on the microcontroller we select there exists different software for coding, compiling, debugging. we need to write source code for that proposed system based on our requirements and compile, debug the code in that software.

After completing all the requirements of software and hardware we need to bring both together to work our

system. For this we need to burn our source code into microcontroller, after burning our source code to microcontroller then connect all input and output modules as per our requirement.

2. Arduino

Arduino Uno is a very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6 analog pins, and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins.

There are many versions of Arduino boards introduced in the market like Arduino Uno, Arduino Due, Arduino Leonardo, Arduino Mega, however, most common versions are Arduino Uno and Arduino Mega. If you are planning to create a project relating to digital electronics, embedded system, robotics, or IoT, then using Arduino Uno would be the best, easy and most economical option.

Fig-2: Arduino types

2.1 Introduction to Arduino

Arduino Uno is a microcontroller board developed by Arduino.cc which is an open-source electronics platform mainly based on AVR microcontroller Atmega328.First Arduino project was started in Interaction Design Institute Ivrea in 2003 by David Cuartillas and Massimo Banzi with the intention of providing a cheap and flexible way to students and professional for controlling a number of devices in the real world.

The current version of Arduino Uno comes with USB interface, 6 analog input pins, 14 I/O digital ports that are used to connect with external electronic circuits. Out of 14 I/O ports, 6 pins can be used for PWM output..It allows the designers to control and sense the external electronic devices in the real This board comes with all the features required to run the controller and can be directly connected to the computer through USB cable that is used to transfer the code to the controller.

Fig-2: ArduinoUNO

Using IDE (Integrated Development Environment) software, mainly developed to program Arduino. IDE is equally compatible with Windows, MAC or Linux Systems; however, Windows is preferable to use. Programming languages like C and C++ are used in IDE. Apart from USB, battery or AC to DC adopter can also be used to power the board. Arduino Uno boards are quite similar to other boards in Arduino family in terms of use and functionality, however, Uno boards don't come with FTDI USB to Serial driver chip. There are many versions of Uno boards available, however, Arduino Nano V3 and Arduino Uno are the most official versions that come with Atmega328 8-bit AVR Atmel microcontroller where RAM memory is 32KB.When nature and functionality of the task go complex, Mirco SD card can be added in the boards to make them store more information.

2.2 Features of Arduino

Arduino Uno comes with USB interface i.e. USB port is added on the board to develop serial communication with the computer.Atmega328 microcontroller is placed on the board that comes with a number of features like timers, counters, interrupts, PWM, CPU, I/O pins and based on a 16MHz clock that helps in producing more frequency and number of instructions per cycle.

It is an open-source platform where anyone can modify and optimize the board based on the number of instructions and task they want to achieve.This board comes with a built-in regulation feature which keeps the voltage under control when the device is connected to the external deviceReset pin is added in the board that reset the whole board and takes the running program in the initial stage. This pin is useful when board hangs up in the middle of the running program; pushing this pin will clear everything up in the program and starts the program right from the beginning.

There are 14 I/O digital and 6 analog pins incorporated in the board that allows the external connection with any circuit with the board. These pins provide the flexibility and ease of use to the external devices that can be connected through these pins. There is no hard and fast interface required to connect the devices to the board. Simply plug the external device into the pins of the board that are laid out on the board in the form of the header.The 6 analog pins are marked as A0 to A5 and come with a resolution of 10bits. These pins measure from 0 to 5V, however, they can be configured to the high-range using analog Reference () function and AREF pin.13KB of flash memory is used to store number of instructions in form of code.Only 5 V is required to turn the board on, which can be achieved directly using USB port or external adopter, however, it can support external power source up to 12 V which can be regulated and limit to 5 V or 3.3 V based on the requirement of the project.

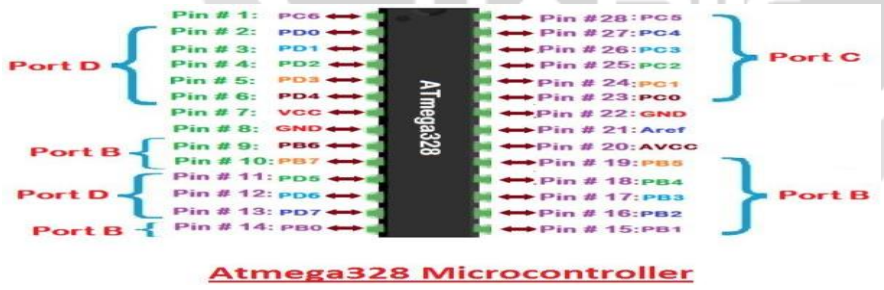

Fig-3: Atmega328 Microcontroller

3.Results

The above figure shows the working of road safety alert system include components like Arduino UNO, Ultrasonic sensor, IR sensor, Motor drive, LED, LCD display and motor. Microcontroller is the heart of the project and it is brain of the device. Ultrasonic sensor measures the distance between vehicle and manhole by using ultrasonic waves.IR sensor detects the either manhole is open or not. LED is used for notifications for output purpose. LCD display displays the

distance and comments related to manhole. Motor rotates both clockwise and anti-clockwise directions. In this project we have three cases:

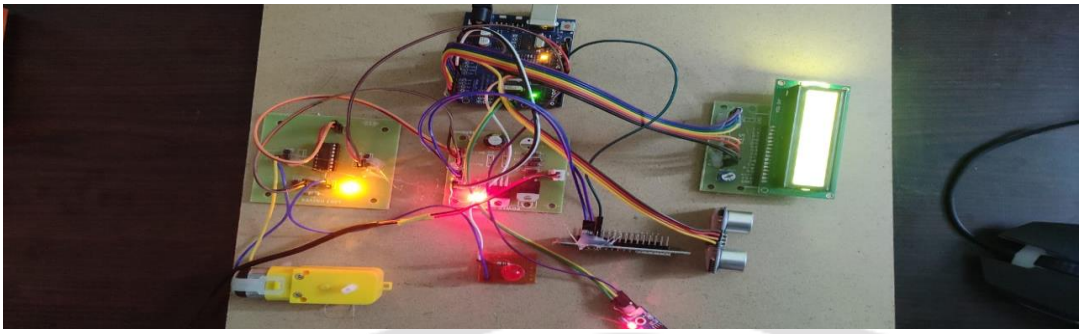

Fig -4: Photograph of working of road safety alert system

*3.*1 Case 1

Initially the manhole is closed.IR sensor detects manhole is close. Ultra sonic sensor measures the distance between vehicle and manhole. Then led is turned off. So motor rotates clockwise direction. LCD displays “MANHOLE IS CLOSED, NO DIVERSIONS”.

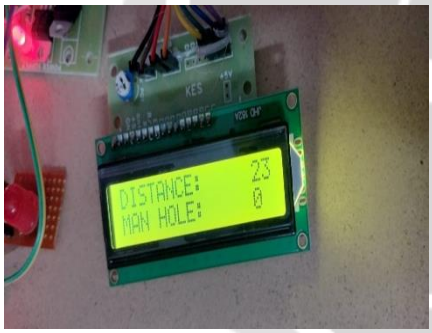

Fig -5: LCD Display 1

Fig -6: Output 1

3.2 Case 2

In this case, IR sensor detects manhole is opened. Then led is turned on, motor rotates anti-clockwise direction. So, it displays “MANHOLE OPENED AND DIVERSION AHEAD”.

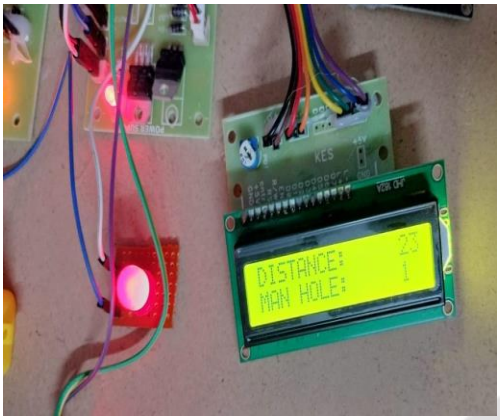

Fig-7: LCD Display 2

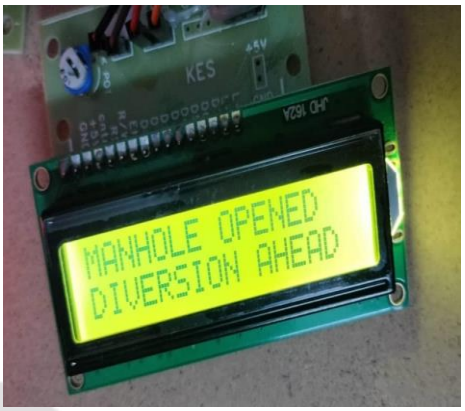

Fig-8: Output 2

3.3 Case 3

At this final case, manhole is opened. But vehicle moving towards the manhole, then LED glows ON. Motor rotates clockwise direction from motor drive. It displays “TAKE CARE AND WORK IN PROGRESS”.

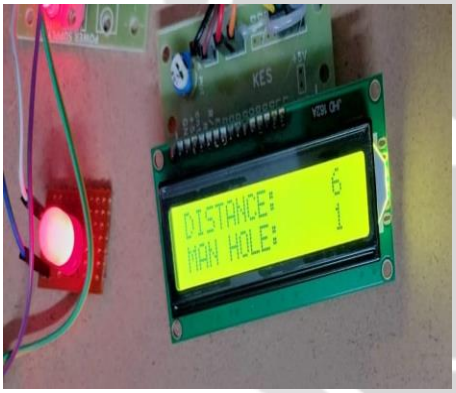

Fig-9: LCD Display 3

Fig-10: Output 3

4. CONCLUSIONS

In conclusion, the Road Safe Alert System represents a significant advancement in road safety technology, offering a comprehensive solution to mitigate potential hazards and improve overall traffic management. Through its real-time notifications and alerts, the system empowers drivers with crucial information about road conditions, construction activities, and other potential obstacles, allowing them to make informed decisions and adapt their driving behaviour accordingly. By enhancing situational awareness and providing early warnings, the system contributes to reducing the frequency and severity of accidents, ultimately saving lives and preventing injuries on the road.

Furthermore, the Road Safe Alert System serves as a valuable tool for urban planners, transportation authorities, and emergency response teams, enabling better coordination and resource allocation during various scenarios, including construction projects, emergency situations, and special events. By leveraging technology to facilitate communication and data sharing among stakeholders, the system supports more efficient traffic management, emergency response coordination, and public safety initiatives. Additionally, the system's

integration with smart city infrastructure and public transportation networks further enhances its utility and effectiveness in promoting safer and more sustainable urban mobility.

Looking ahead, the Road Safe Alert System holds immense potential for future enhancements and expansions, including the integration of additional sensors, the development of predictive analytics capabilities, and the incorporation of advanced communication technologies such as vehicle-to-infrastructure (V2I) and vehicle-to-everything (V2X) connectivity. By embracing innovation and collaboration, stakeholders can continue to leverage the power of technology to address emerging challenges and opportunities in road safety and urban mobility, ultimately creating safer, more resilient, and more liveable cities for all.

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