IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 10, Issue 5, May 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.165

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005150|

Augmented Reality Based Driver Assistance System

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Abstract: The paper presents an efficient and reliable approach to detect pedestrians, detect driver drowsiness, find distance between obstacle and vehicle for driver assistance using Augmented Reality. While autonomous vehicles are almost assuredlythe future of personal transportation, we are likely many years from seeing self-driving cars become as ubiquitous as manually-driven ones, as the auto industry has a myriad of government regulations and other constraints to contend with. With cars, there's no cumbersome, head worn display to act as a hurdle to adoption, as content is projected onto windshields or dashboard-mounted displays. Miniaturization of computing hardware is also not as big a concern with AR in cars when compared to the challenges of embedding the same technology in a pair of smart glasses. Whenever the obstacle detected first buzzer will alert, at a same time data transferred to AR glass. Experimental results suggest that the proposed method is able to achieve very good results in terms of detecting driver drowsiness and finding distance between obstacle and vehicle.

KEYWORDS: Augmented reality, pedestrians, driver drowsiness, AR glass, buzzer

I. INTRODUCTION

Cars are currently one of the most commonly used mode of transportation worldwide. Despite the advances in the automotive industry, the safety of car transportation is still an issue. Number of traffic deaths in the US in 2013 was over 34 thousand. Despite numerous electronic safety mechanisms, the driver of the vehicle remains the key factor. Recently, advances in sensors, computer vision and machine learning have enabled development of sophisticated driver assistance systems which provide a number of useful information in real-time. Pedestrian accidents can be limited with the use of pedestrian detection systems, that can detect sudden crossings. Efficient recognition of pedestrians is possible also during the night-time by employing infrared sensors. Lane detection systems can alert the driver to unintentional lane departure. Recent methods are able to deal with both straight and curved lanes, under different weather conditions and in the presence of shadows and obstacles. Robust traffic sign detection and recognition has been proposed with the use of Convolutional Neural Networks. Detection of other vehicles on the road is also important in terms of safety and can be addressed with deep learning methods. This work was supported by AGH University of Science and Technology, Faculty of Computer Science, Electronics and Telecommunications as part of statutory project. While systems for analysing the vehicle, environment are numerous and advanced, the means of presenting information to the driver are rather crude. Typically, a smartphone or a small dedicated display is employed. While providing important information, such setups create also a distraction for the driver, who needs to constantly switch between looking at the road and at the display. Therefore, a new manner of conveying information to the driver is needed. Automotive companies work on presenting information directly on the vehicle's windscreen in a semi-transparent manner. This technology, however, is rather still immature, as it allows to display graphical contents, but lacks the ability to create a mixed view of real world and virtually added information. With the use of Augmented Reality (AR) such mixed views are possible by displaying generated information on a semi-transparent display and therefore augmenting the view of the real world rather than creating a separate, distracting view. Possible applications are numerous - highlighting pedestrians and road signs, displaying distance to other vehicles or providing precise navigation, by overlaying the planned route directly on the view of the road.

An embedded system is a controller programmed and controlled by a real-time operating system (RTOS) with a dedicated function within a larger mechanical or electrical system, often with real-time consumption of embedded systems computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. Ninety-eight percent of all microprocessors are manufactured to serve as embedded system component.

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Examples of properties of typical embedded computers when compared with general-purpose counterparts are low power consumption, small size, rugged operating ranges, and low per-unit cost. This comes at the price of limited processing resources, which make them significantly more difficult to program and to interact with.However, by building intelligence mechanisms on top of the hardware, taking advantage of possible existing sensors and the existence of a network of embedded units, one can both optimally manage available resources at the unit and network levels as well as provide augmented functions, well beyond those available. For example, intelligent techniques can be Embedded systems are commonly found in consumer, industrial, automotive, medical, commercial and military applications. Telecommunications systems employ numerous embedded systems from telephone switches for the network to cell phones at the end user. Computer networking uses dedicated routers and network bridges to route data.

Consumer electronics include MP3 players, mobile phones, video game consoles, digital cameras, GPS receivers, and printers. Household appliances, such as microwave ovens, washing machines and dishwashers, include embedded systems to provide flexibility, efficiency and features.

II. HARDWARE DESCRIPTIONS

Arduino UNO

Power:

VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

- 5V. This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.

- 3V 3. A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

- GND. Ground pins.

Memory

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library). Input and Output Each of the 14 digital pinson the Uno can be used as an input or output, using pin Mode (), digital Write (), and digital Read () functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kilo Ohms.

In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins areconnected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt () function for details.

- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog Write () function.

- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

2.LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on,when the

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pin is LOW, it's off. The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e., 1024 different values). By default, they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog Reference () function. Additionally, some pins have specialized functionality:

- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library. There are a couple of other pins on the board:
- AREF. Reference voltage for the analog inputs. Used with analog Reference ().
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board. See also the mapping between Arduino pins and ATmega328 ports. Themapping for the Atmega8, 168, and 328 is identical. Communication the Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers.
- The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed.
- However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.
- **2.2 IR 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 types of sensors measure only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infrared sensor. 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.
- **IR Sensor Circuit Diagram and Working Principle**

  An infrared sensor circuit is one of the basic and popular sensor module in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real time. This circuit comprises of the following components

- LM358 IC 2 IR transmitter and receiver pair
- Resistors of the range of kilo ohms.
- Variable resistors.
- LED (Light Emitting Diode).

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Circuit diagram

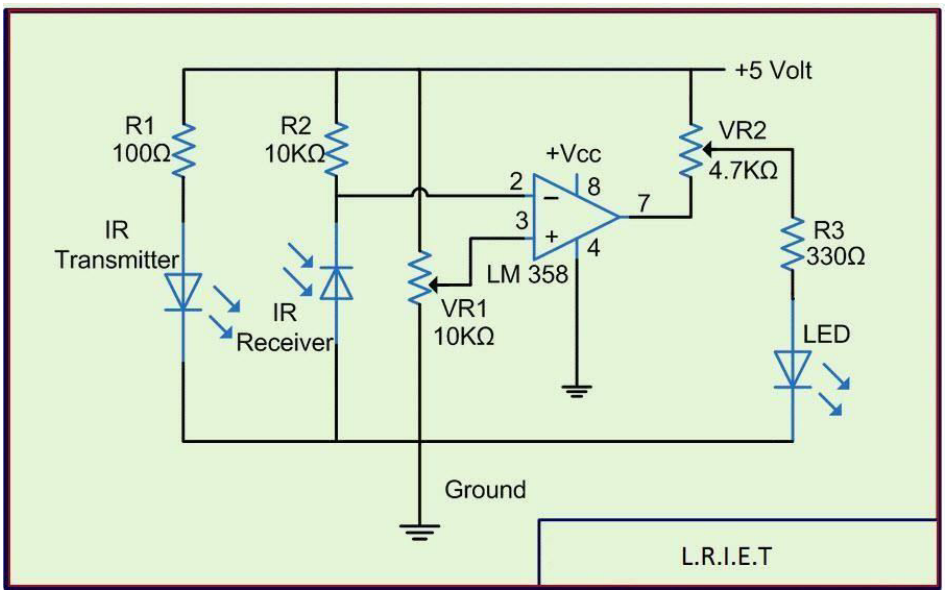

Fig.1. circuit diagram

In this project, the transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays. Since this variation cannot be analyzed as such, therefore this output can be fed to a comparator circuit. Here an operational amplifier (op-amp) of LM 339 is used as comparator circuit.

When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non- inverting input of the comparator IC (LM339). Thus, the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives signal to the potential at the inverting input goes low. Thus, the output of the comparator (LM 339) goes high and the LED starts glowing. Resistor R1 (100), R2 (10k) and R3 (330) are used to ensure that minimum 10 mA current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2 (preset=5k) is used to adjust the output terminals. Resistor VR1 (preset=10k) is used to set the sensitivity of the circuit Diagram. Read more about IR sensors.

Ultrasonic senor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns.

Laws of physics for sound waves

Sound waves are having specific frequencies or number of oscillations per second. Humans can detect sounds in a frequency range from about 20Hz to 20 KHz. However, the frequency range normally employed in ultrasonic detection is 100 KHz to 50MHz. The velocity of ultrasound at a particular time and temperature is constant in a medium.

W = C/F (or) W = CT

Where W = Wave length

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C = Velocity of sound in a medium F = Frequency of wave

T=Time Period

The most common methods of ultrasonic examination utilize either longitudinal waves or shear waves. The longitudinal wave is a compression wave in which the particle motion is in the same direction of the propagation wave. The shear wave is a wave motion in which the particle motion is perpendicular to the direction of propagation. Ultrasonic detection introduces high frequency sound waves into a test object to obtain information about the object without altering or damaging it in any way. Two values are measured in ultrasonic detection.

The amount of time, taking for the sound to travel through the medium and amplitude of the received signal. Based on velocity and time thickness can be calculated.

Thickness of material = Material sound velocity X Time of Fight

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns.

ESP8266 MODULE:

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by manufacturer Espressif Systems in Shanghai, China.

The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third- party manufacturer Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at first there was almost no English-language documentation on the chip and the commands it accepted.[2] The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation

Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

III. SOFTWARE DESCRIPTIONS

Arduino IDE

The Arduino IDE is incredibly minimalistic, yet it provides a near-complete environment for most Arduino-based projects. The top menu bar has the standard options, including "File" (new, load save, etc.), "Edit" (font, copy, paste, etc.), "Sketch" (for compiling and programming), "Tools" (useful options for testing projects), and "Help". The middle section of the IDE is a simple text editor that where you can enter the program code. The bottom sectionof the IDE is dedicated to an output window that is used to see the status of the compilation, how much memory has been used, any errors that were found in the program, and various other useful messages.

Embedded C

Embedded C is most popular programming language in software field for developing electronic gadgets. Eachprocessor used in electronic system is associated with embedded software.

Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all-device workingis based on microcontroller that are programmed by embedded C.

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IV. RESULTS

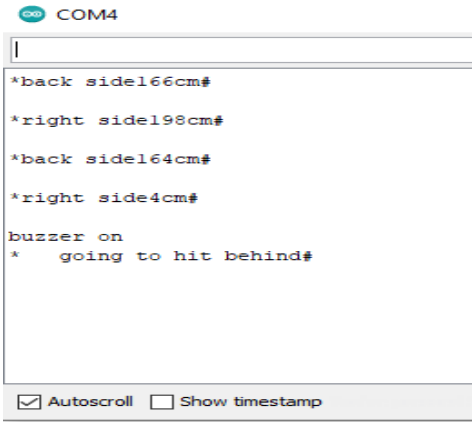

Fig.2.VEHICLE DETECTION

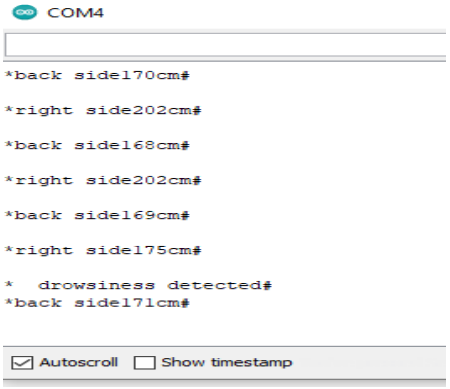

Fig.3.DROWSINESS DETECTION

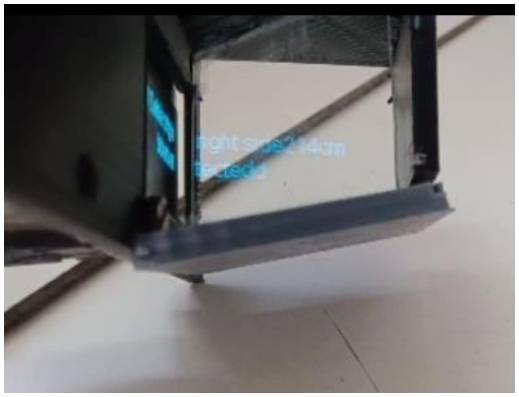

Fig.4. OUTPUT IN DISPLAY

V. CONCLUSION

In this work we proposed a system which employs an AR-headset for providing a driver with important information via a mixed view of real-world and virtually generated data. Our implementation proved the viability of such system. As we presented only a proof-of-concept system, there is still plenty of room for development in this area.

To conclude, we believe that AR systems may be the future of driver assistance systems and an important part of the automotive industry in the upcoming years.

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INNO SPACE
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ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

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