DESIGN & ENHANCEMENT OF CRASH RECOVERY AND PREDICTION USING BLACK BOX BASED ON MEMS TECHNOLOGY

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***Abstract*-Vehicle electronics plays a major role in the application of automotives and it is highly applicable in preserving the human lives. Enormous technologies are involved in the field of vehicle applications by electronics. Much kind of sensors are implemented in the vehicle and it is used in the real time applications effectively. In this paper, a real-time automobile tracking system via Google Earth is presented. The system included two main components: a transmitting embedded module to interface in-vehicle GPS and GSM devices in order determine and Send automobile location and status information via SMS. The second stationary module is a receiving module to collect and process the transmitted information to a compatible format with Google Earth to remotely monitor the automobile location and status online. The transmit location of the vehicle has been filtered using Kalman filter to achieve accurate tracking. The *2DRMS* accuracy of estimated vehicle coordinates has been enhanced. The accuracy of filter coordinates was less than 15 meters compared to about 43 meters for transmitted co-ordinates received by in vehicle GPS module. Panic switch use to control the sending information. Radiation jammer use to control the incoming calls when driving.**

Keywords: Kalman filter, GPS, GSM, Radiation jammer

I.INTRODUCTION

The ability to accurately detect a vehicles location and its status is the main goal of automobile trajectory monitoring systems. Also the high demand of automobiles has also increased the traffic hazards and the road accidents. This is because of the lack of best emergency facilities available in our country this design is a system which can detect accidents in significantly less time and sends the basic information to first aid center within a few seconds covering geographical coordinates, the time and angle in which a vehicle accident had occurred. This alert message is sent to the rescue team in a short time, which will help in saving the valuable lives. These systems are implemented using several hybrid techniques that include wireless communication, geographical positioning and embedded applications.

This technology automatically detecting the accident and a hardware tracking device based on GSM/GPS technology informing at the occurrence of accident with sufficient details like exact location and time at which accident happened. This project will establish a communication between the control station and the unit installed in vehicles. Vehicles will have GPS/GSM enabled tracking modules and will be tracked in real time using cellular networks. The software embedded in the microcontroller will control the various operations of the device by monitoring waveform from the vibration sensor. In case of accident the device will send an alert message along with location data from GPS module to control station using GSM network.

II.LITERATURE REVIEW

"Design and Development of Automatic Vehicle accident detection & Localization of Automobile Using Bluetooth Technology." Nitin Thakre, Prof. Nitin Raut, Prof. Abdulla Shaik

The advantage of technology has also increased the traffic hazards and the road accident take place frequently which causes huge loss of life and property because of the poor emergency facilities. Our project will provide an optimum solution to this draw back. An integrated Cell phone GPS-GSM system is proposed to track vehicles using Google Earth application develop in

Android application for mobile system. The remote module has a Bluetooth mounted on the moving vehicle with attached accident detecting sensor to identify if accidents happens. Here Bluetooth will be the medium of communication with the user mobile for activating the GPS position of the cell phone. In this case cell phone will get activated its application and track the current position of the vehicle and send it to the remote located predefined phone for tracking the real time position of the situation. After data processing, Google Earth application can be used to view the current location and status of each vehicle. To detect the real time localization of the vehicle using Bluetooth technology with GPS locator in cell phone using android application.

If an impact is strong enough to go up to the chassis bending panels and body, it is definitely a valid crash. This will also avoid triggering in the event of minor nonlife threatening collisions that happens more often. Since it is only a push button trigger it can be placed in many places of the vehicle so that angular, roof collapse and side-impacts are covered as shown in and shows possible impact switch (red) placements inside the car frame (green). Device contains two Maxim DS18B20 Digital Temperature sensors. A trigger occurs if cabin temperature exceeds 80°C and engine temperature trigger is at 120°C. We know that this is different for different vehicle and regions and therefore can be adjusted accordingly in the programming.

It enables intelligent detection of an accident at any place and reports about the accident on predefined numbers. Our system consists of two parts, alarming part and messaging part. The hardware includes SONAR ranging modules, vibration sensor, three modules GPS receiver (NMEA), Microcontroller (AT89S51), GSM modem (SIM 900D) and an Alarm. When distance is too short between the vehicles and obstacle then alarm will be "ON" as an indicator to move vehicle in other direction which is safer but when a vehicle faces accident despite of alarm, immediately vibration sensor will detect the signal and then Microcontroller sends the alert message through the GSM modem including the location to predefined numbers that can be reserved for a rescue team. Our designed system has been tested at different locations and found to be effectively working by sending alert messages to mobile phone user.

"A study on car involvement in road traffic accidents in Bangladesh" H.M. Ahsan, M.A. Raihan & M. Rahman

This paper has mainly highlighted the general characteristics of car fatal accidents and makes an attempt to establish the most common types of fatal accidents and the causal factors. The fatal accident of car is much more than injury and collision only accidents. In urban areas, the car traffic is huge compared to rural areas and the accident rate is almost double. So the drivers of car in city areas should be trained properly. Age of 26 to 35, casualties is very high. Most of the accidents occur due to careless driving and high speed and most fatalities happen due to unwillingness of the drivers for wearing seat-belts. Most frequent accident types were rear-end, hit pedestrians and head-on collision. Higher portion of car accidents occur due to NMV, truck, bus, tempo etc. Almost all accidents occur at dry and sealed surface, good and straight road at fair weather. Countermeasures stated above might help in minimizing the fatality rate of car accident.

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or motorbike plunged in to the water). We have used Grove Moisture sensor as our electro conductivity sensor. Contains Latitude, Longitude, Speed (in km/h), Altitude and number of Satellites are Available.

III.SYSTEM DESIGN

A.PROPOSED SCHEME

To build an integrated system for emergency rescue services in the event of road accidents by black box system. The project focuses on building an infrastructure which vehicle safety authorities can enhance the crash reports post-crash analysis, record of the event and reduces the time to arrive at the crash location.

In the event of an accident it is reported to the police or a hospital by the locals in the area if they have discovered the wreckage or the incident happened on sight. Usually the caller is uncertain of the injuries and according to a research in delay of ambulance to crash location reveals that even with emergency services in place it can take up to 5 minutes or more in the developed countries for an ambulance to arrive

B.TECHNIQUES

- Vehicle to vehicle communication has been implemented instead of GSM.
- Panic switch use to control the sending information.
- The information sent from one vehicle to another network station.
- The information has been sent to nearby base station or police station or hospital or home.
- Radiation jammer use to control the incoming calls when driving.

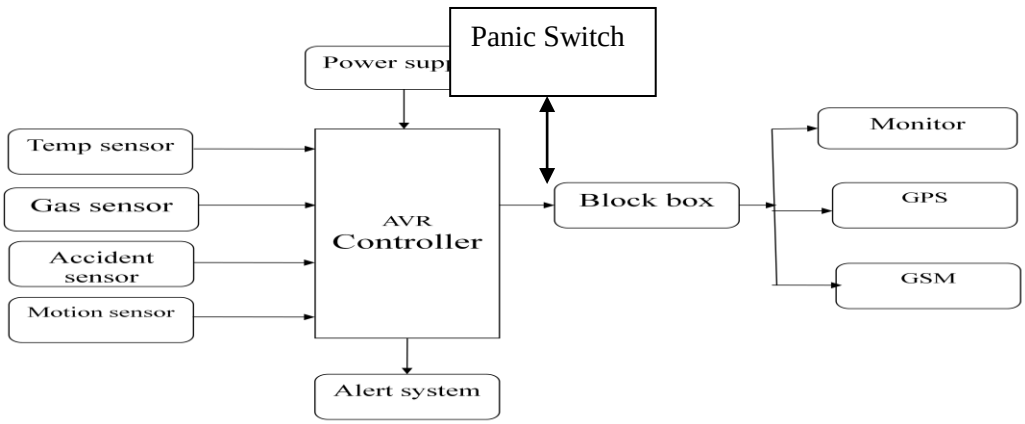
C.HARDWARE REQUIREMENTS

1. Black box
2. GPS Module
3. Temperature Sensor
4. Vibration sensor
5. Tilt sensor
6. GSM module
7. LCD
8. Power supply

D.SOFTWARE REQUIREMENTS

1. Keil u Vision4IDE
2. Proetus

E.BLOCK DIAGRAM



It does not use the internal satellite navigation of the car. It has its own GPS module and antenna. We have built the device around the idea that it can be plug-and-play, low power consumption and will be compatible with the vast number of vehicles regardless of make and model at the same time be very reasonably priced so that it can be widely deployed. Physical Damage to the car is one of the trigger events. In the likelihood that a vehicle has damaged key areas of the car it will act as a trigger. It is simply a push button that gets pressed. It is placed with some protection between the chassis and the frame of the car.

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• Temperature for both cabin and engine bay is also recorded in a file to figure out events such as a blown engine that resulted in fire is actually an instant occurrence or did it gradually came to that condition.
• Lastly the Acceleration and Tilt data to be recorded on a file at 100Hz, because a speed bump may last only a fraction of a second. Sensor used is a single unit MPU6050, which is a combination of accelerometer and gyroscope. Data saved are Yaw, Pitch, Roll in degrees and Vertical, Horizontal and Lateral G-Forces. This will allow crash investigators find out how the vehicle was being driven and what road surface conditions it was being driven over.

G.APPLICATIONS

1. Road safety in roadways.
2. In-vehicle monitoring.
3. Accident detection.
4. Information gathering.
5. Rescue system.
6. Steel industry Monitor temperature and chemistry throughout the steel making process
7. Heating appliance safety Thermocouples in fail-safe mode are used in ovens and water heaters to detect if pilot flame is burning to prevent fire and health hazard
8. Manufacturing Used for testing prototype electrical and mechanical apparatus
9. Process plants Chemical production plants and refineries use computer programs to view the temperature at various locations. For this situation, a number of thermocouple leads are brought to a common reference block.

GSM

GSM technology:

GSM refers to second-generation wireless telecommunications standard for digital cellular services. First deployed in Europe, it is based on TDMA (Time Division Multiple Access) technology. GSM uses three frequency bands: 900 MHz, 1800 MHz and 1900 MHz. Dual-band phones operate on two out of three of these frequencies, while tri-band phones operate on all three frequencies.

It is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones. The GSM standard was developed as a replacement for first generation (1G) analog cellular networks, and originally described a digital, circuit switched network optimized for full duplex voice telephony.

This was expanded over time to include data communications, first by circuit switched transport, then packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS).Further improvements were made when the 3GPP developed third generation (3G) UMTS standards followed by fourth generation (4G) LTE Advanced standards."GSM" is a trademark owned by the GSM Association.

Mobile station

The mobile station (MS) consists of the physical equipment, such as the radio transceiver, display and digital signal processors, and a smart card called the Subscriber Identity Module (SIM). The SIM provides personal mobility, so that the user can have access to all subscribed services irrespective of both the location of the terminal and the use of a specific terminal. By inserting the SIM card into another GSM cellular phone, the user is able to receive calls at that phone, make calls from that phone, or receive other subscribed services.

The mobile equipment is uniquely identified by the International Mobile Equipment Identity (IMEI). The SIM card contains the International Mobile Subscriber Identity (IMSI), identifying the subscriber, a secret key for authentication, and other user information. The IMEI and the IMSI are independent, thereby providing personal mobility. The SIM card may be protected against unauthorized use by a password or personal identity number.

Base station subsystem

The Base Station Subsystem is composed of two parts, the Base Transceiver Station (BTS) and the Base Station Controller (BSC). These communicate across the specified bis interface, allowing (as in the rest of the system) operation between components made by different suppliers.

The Base Transceiver Station houses the radio transceivers that define a cell and handles the radio protocols with the Mobile Station. In a large urban area, there will potentially be a large number of BTSs deployed. The requirements for a BTS are ruggedness, reliability, portability, and minimum cost.

The Base Station Controller manages the radio resources for one or more BTSs. It handles radio channel setup, frequency hopping, and handovers, as described below. The BSC is the connection between the mobile and the Mobile service Switching Center (MSC). The BSC also translates the 13 kbps voice channel used over the radio link to the standard 64 kbps channel used by the Public Switched Telephone Network or ISDN.

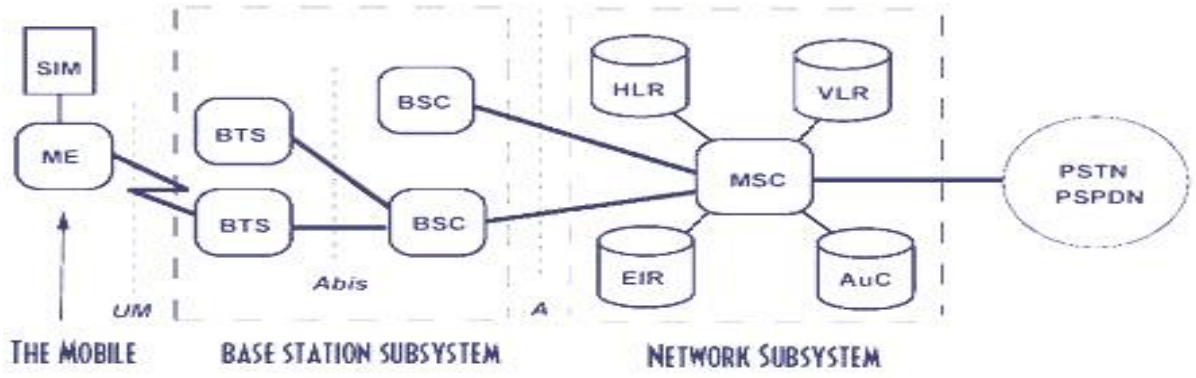
Network subsystem

The central component of the Network Subsystem is the Mobile services Switching Center (MSC). It acts like a normal switching node of the PSTN or ISDN, and in addition provides all the functionality needed to handle a mobile subscriber, such as registration, authentication, location updating, handovers, and call routing to a roaming subscriber. These services are provided in conjunction with several functional entities, which together form the Network Subsystem. The MSC provides the connection to the public fixed network (PSTN or ISDN), and signaling between functional entities uses the ITU Signalling System Number 7 (SS7), used in ISDN and widely used in current public networks.

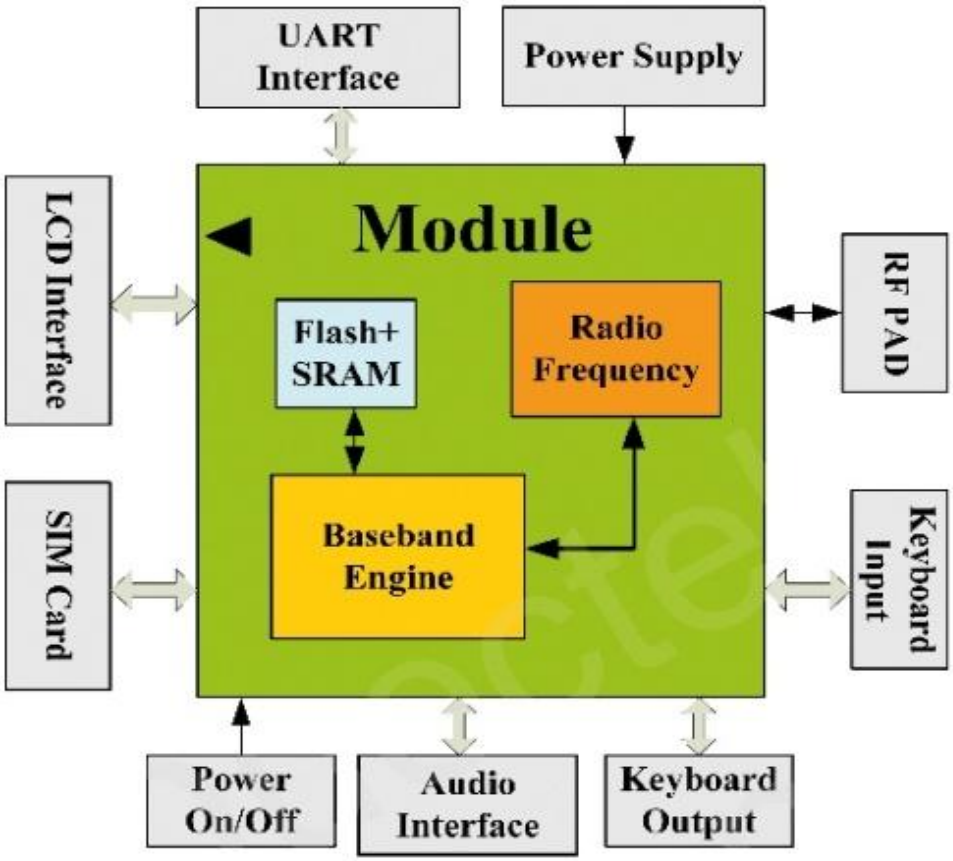
The Home Location Register (HLR) and Visitor Location Register (VLR), together with the MSC, provide the call routing and (possibly international) roaming capabilities of GSM. The HLR contains all the administrative information of each subscriber registered in the corresponding GSM network, along with the current location of the mobile. The current location of the mobile is in the form of a Mobile Station Roaming Number (MSRN) which is a regular ISDN number used to route a call to the MSC where the mobile is currently located. There is logically one HLR per GSM network, although it may be implemented as a distributed database.

The Visitor Location Register contains selected administrative information from the HLR, necessary for call control and provision of the subscribed services, for each mobile currently located in the geographical area controlled by the VLR. Although each functional entity can be implemented as an independent unit, most manufacturers of switching equipment implement one VLR together with one MSC, so that the geographical area controlled by the MSC corresponds to that controlled by the VLR, simplifying the signaling required. Note that the MSC contains no information about particular mobile stations - this information is stored in the location registers.

The other two registers are used for authentication and security purposes. The Equipment Identity Register (EIR) is a database that contains a list of all valid mobile equipment on the network, where each mobile station is identified by its International Mobile Equipment Identity (IMEI). An IMEI is marked as invalid if it has been reported stolen or is not type approved. The Authentication Center is a protected database that stores a copy of the secret key stored in each subscriber's SIM card, which is used for authentication and ciphering of the radio channel.



SIM - Subscriber Identity Module
MS - Mobile Station
BTS - Base Transceiver Station
BSC - Base Station Controller
MSC - Mobile services Switching Center
PSTN - Public Switched Telecomm Network
ISDN - Integrated Services Digital Network
HLR - Home Location Register
VLR - Visitor Location Register
EIR - Equipment Identity Register
AC - Authentication Center
VLR - Visitor Location Register
GSM Module



GSM MODEM

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone.

The advantages of GSM

GSM networks enjoy wide international coverage. The use of a SIM (Subscriber Identity Module) card makes it easy to switch between different handsets and allows for the quick and easy import of data such as contacts and text-messages.the amount of battery-supported 'talk-time' is generally higher on GSM phones.

RS-232:

The MAX232 is an integrated circuit, first created by Maxim Integrated Products, that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals.

The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as supply design does not need to be made more complicated just for driving the RS-232 in this case.

The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V.

The later MAX232A is backwards compatible with the original MAX232 but may operate at higher baud rates and can use smaller external capacitors – 0.1 µF in place of the 1.0 µF capacitors used with the original device. The newer MAX3232 is also backwards compatible, but operates at a broader voltage range, from 3 to 5.5 V

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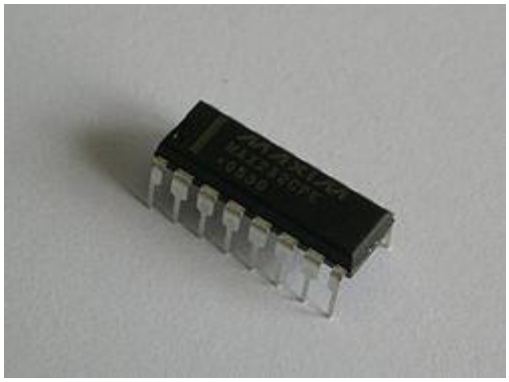

VOLTAGE LEVEL:

It is helpful to understand what occurs to the voltage levels. When a MAX232 IC receives a TTL level to convert, it changes a TTL Logic 0 to between +3 and +15 V, and changes TTL Logic 1 to between -3 to -15 V, and vice versa for converting from RS232 to TTL. This can be confusing when you realize that the RS232 Data Transmission voltages at a certain logic state are opposite from the RS232 Control Line voltages at the same logic state. To clarify the matter, see the table below. For more information see RS-232 Voltage Levels.

IV.RESULT

RS232 Line Type & Logic Level	RS232 Voltage	TTL Voltage to/from MAX232
Data Transmission (Rx/Tx) Logic 0	+3 V to +15 V	0 V
Data Transmission (Rx/Tx) Logic 1	-3 V to -15 V	5 V
Control Signals (RTS/CTS/DTR/DSR) Logic 0	-3 V to -15 V	5 V
Control Signals (RTS/CTS/DTR/DSR) Logic 1	+3 V to +15 V	0 V

LCD:

A liquid crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements. LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones, and have replaced cathode ray tube (CRT) displays in most applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they do not suffer image burn-in. LCDs are, however, susceptible to image persistence.

The LCD screen is more energy efficient and can be disposed of more safely than a CRT. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically modulated optical device made up of any number of segments filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome. Liquid crystals were first discovered in 1888. By 2008, worldwide sales of televisions with LCD screens exceeded annual sales of CRT units; the CRT became obsolete for most purposes.

SPECIFICATION:

Important factors to consider when evaluating an LCD:

Resolution versus range

Fundamentally resolution is the granularity (or number of levels) with which a performance feature of the display is divided. Resolution is often confused with range or the total end-to-end output of the display. Each of the major features of a display has both a resolution and a range that are tied to each other but very different. Frequently the range is an inherent limitation of the display while the resolution is a function of the electronics that make the display work.

Spatial performance

LCDs come in only one size for a variety of applications and a variety of resolutions within each of those applications. LCD spatial performance is also sometimes described in terms of a "dot pitch". The size (or spatial range) of an LCD is always described in terms of the diagonal distance from one corner to its opposite. This is an historical remnant from the early days of CRT television when CRT screens were manufactured on the bottoms of glass bottles, a direct extension of cathode ray tubes used in oscilloscopes. The diameter of the bottle determined the size of the screen. Later, when televisions went to a squarer format, the square screens were measured diagonally to compare with the older round screens

Temporal/timing performance

Contrary to spatial performance, temporal performance is a feature where smaller is better. Specifically, the range is the pixel response time of an LCD, or how quickly a sub pixel's brightness changes from one level to another. For LCD monitors, this is measured in black to black gray to gray. These different types of measurements make comparison difficult Further, this number is almost never published in sales advertising.

Color performance:

There are many terms to describe color performance of an LCD. They include color gamut which is the range of colors that can be displayed and color depth which is the color resolution or the resolution or fineness with which the color range is divided. Although color gamut can be expressed as three pairs of numbers, the XY coordinates within color space of the reddest red, greenest green, and bluest blue, it is usually expressed as a ratio of the total area within color space that a display can show relative to some standard such as saying that a display was "120% of NTSC". NTSC is the National Television Standards Committee, the old standard definition TV specification. Color gamut is a relatively straight forward feature. However with clever optical techniques that are based on the way humans see color, termed **color stretch**, colors can be shown that are outside of the nominal range of the display. In any case, color range is rarely discussed as a feature of the display as LCDs are designed to match the color ranges of the content that they are intended to show. Having a color range that exceeds the content is a useless feature

Brightness and contrast ratio:

Contrast ratio is the ratio of the brightness of a full-on pixel to a full-off pixel and, as such, would be directly tied to brightness if not for the invention of the blinking backlight (or burst dimming). The LCD itself is only a light valve, it does not generate light; the light comes from a backlight that is either a fluorescent tube or a set of LEDs. The blinking backlight was developed to improve the motion performance of LCDs by turning the backlight off while the liquid crystals were in transition from one image to another. However, a side benefit of the blinking backlight was infinite contrast. The contrast reported on most LCDs is what the LCD is qualified at, not its actual performance. In any case, there are two large caveats to contrast ratio as a measure of LCD performance.

Color depth or **color support**

It is sometimes expressed in bits, either as the number of bits per sub-pixel or the number of bits per pixel. This can be ambiguous as an 8-bit color LCD can be 8 total bits spread between red, green, and blue or 8 bits each for each color in a different display. Further, LCDs sometimes use a technique called dithering which is time averaging colors to get intermediate colors such as alternating between two different colors to get a color in between. This doubles the number of colors that can be displayed; however this is done at the expense of the temporal performance of the display. Dithering is commonly used on computer displays where the images are mostly static and the temporal performance is unimportant.

When color depth is reported as color support, it is usually stated in terms of number of colors the LCD can show. The number of colors is the translation from the base 2-bit numbers into common base-10. For example, 8-bit color is 2 to the 8th power, which is 256 colors. 24-bit color is 2 to the 24th power, or 256 x 256 x 256, a total of 16,777,216 colors. The color resolution of the human eye depends on both the range of colors being sliced and the number of slices; but for most common displays the limit is about 28-bit color LCD TVs commonly display more than that as the digital processing can introduce color distortions and the additional levels of color are needed to ensure true color.

Advantages

- Very compact and light.
- Low power consumption. On average, 50-70% less energy is consumed than CRT monitors.
- No geometric distortion.
- The possible ability to have little or no flicker depending on backlight technology.
- Usually no refresh-rate flicker, as the LCD panel itself is usually refreshed at 200 Hz or more, regardless of the source refresh rate.
- Is very thin compared to a CRT monitor, which allows the monitor to be placed farther back from the user, reducing close-focusing related eye-strain.
- Razor sharp image with no bleeding/smearing when used at native resolution.
- Emits less electromagnetic radiation than a CRT monitor.
- Not affected by screen burn-in, though an identical but less severe phenomenon known as image persistence is possible.
- Can be made in almost any size or shape.
- No theoretical resolution limit.

V.CONCLUSION

Overall such devices and systems can be the changing factor in road safety. Life is priceless and we should be doing whatever possible to make roads safer. WHO has already predicted 1.9 million casualties by the year 2020. Bangladesh is especially at risk as the country is being reformed by building more bridges, roads and better transportation networks and new areas emerges to develop. Gradually with assistance from both the vehicle owners and the Government assisting in deployment of such devices in vehicles, we can reduce the impact from the ever so concerning issue of road accidents. In addition it will help save lives, aid in better data collection and build an infrastructure solution using Emergency Crash Reporting Software to support the rescue services of the country.

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