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Optimizing Road Tunnel Safety and Security system Using TCP/IP

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Abstract: ***With the increasing number of tunnels under construction or in planning throughout the world, and the growing volume of traffic using existing tunnels, safety issues are becoming increasingly important. Incidents and accidents in road tunnels may be no more frequent than those on the open road; indeed road tunnels can provide a safer, more controlled driving environment for road users. Thinking about driving through a tunnel, everybody, at least for a second, thinks about the possible dangers. However, today tunnels are the essential parts of major highways and we have to make them as safe and as comfortable as possible. We are used to seeing tunnel equipment like electricity and ventilation system since long tunnels have started to be built. But today, in the age of such high traffic density, that is not enough to keep the drive through the tunnel safe. The long and high traffic tunnel required a remote control system for central control and monitoring of road traffic, lighting, ventilation, fire fighting, annunciation. Control centres are required and located at opposite ends of the tunnel. The main control centre is responsible for the day-to-day operations of the system and is manned 24 hours a day, 365 days a year.***

Key Words: **Tunnels, Construction, Safety issues, Remote control System.**

I. INTRODUCTION

With the development of transport infrastructure, construction of very long tunnels and an increasing flow of vehicles, it is often seen that tunnel accidents can take away a large number of people's lives and make extremely large material. This has led to a significant upgrade of safety standards, especially when it comes to fire protection. The main issue in the case of fire is the wind, or the inflow of fresh air that rekindles the fire and leads to a complete inability of rescue teams. This is the reason why it is very important to monitor the wind speed across both access sides of long tunnels. This paper presents a description of the system for collecting data on wind speed at both tunnel portals. The greatest attention is given to the reliability of the system in all segments, especially in the field of communication. The system consists of peripheral devices for data acquisition and a central computer with a database. Following the principle "the simpler the more reliable": The peripheral hardware is realized as a microcontroller device without a hard drive, cooler or other less reliable elements. Data transfer from the peripherals to the central computer is realized via UDP protocol. For communication paths, the existing Ethernet infrastructure in the tunnel is used. This infrastructure is the backbone of all vital systems in the tunnel with high priority maintenance. The system is designed to be universal. In this sense, the peripheral devices can be connected to other types of sensors (digital or analogue) such as thermometers, carbon monoxide sensors (CO sensors), luminosity sensors, sound sensors, etc.

Each computer in the Supervisory Control and Data Acquisition system needs to communicate with the main control. Possible emergencies if they arise:

1. Fire: The heat builds up very quickly. That is why fire detection and ventilation systems, and emergency exits, must be provided, the emergency services must be summoned immediately, and tunnel operators must be able to put emergency plans into operation seamlessly.

2. Fuel Level: If the vehicle's fuel is critically low, the vehicle would certainly stop inside tunnel which causes disturbances in traffic situations.

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3. Air Quality Systems: Due to the pollution the quality of the air degrades, which intern cause problems in respiratory systems to the people driving in tunnel. It may turn much worse if the drivers fell unconscious due to their respiratory problems this is one of the major issues to cause accidents.

To avoid this ventilations are equipped with motors which evacuates air pollution. 4. Wind flow: The main issue in the case of fire is the wind, or the inflow of fresh air that rekindles the fire and leads to a complete inability of rescue teams. This is the reason why it is very important to monitor the wind speed across both access sides of long tunnels. 5. Accident Detection: Accidents inside of tunnels cause serious traffic problems not only to the particular vehicle but to all the vehicles inside the tunnel, the accident detection have to be intimated to the other vehicles in order to avoid further damagec. Keywords: Anemometer, Central Computer, Microcontroller, Data Acquisition Module, Tunnel Portals, Wind Speed.

II. PROPOSED SYSTEM

The main aim the project is to monitor, control and prevent the effect of accidents and in-convince inside Tunnel due to various parameters such as Fire, Fuel Level, Air Quality Systems, Wind flow, and Accident Detection. The system consists of: - Anemometer (EVT-11K), - Data acquisition module (PLC-EC2010), - PC application and - Server with database. Fig. 1 shows the block diagram of the implemented system. Fig. 1 &2. The block diagram of the implemented wind speed measurement and alert system. Anemometer and data acquisition module are set at both tunnel portals. The anemometer provides signal proportional to the current wind speed. The data acquisition module receives the signal, processes it and sends data to the PC application, via LAN network. The PC application receives data and records it into the database. Furthermore, the PC application provides a graphical and numerical representation of the wind speed at the tunnel portals. In the case that wind exceeds the set threshold, PC application alerts the responsible personnel. The EVT-11K anemometer generates a sinusoidal signal whose frequency is proportional to the wind speed. The output impedance of the anemometer is 520Ω. At low wind speeds, the signal amplitude is approximately 1V, while at speeds above 70km/h the amplitude exceeds 2V. Anemometers are connected into the system via PLCEC2010 data acquisition modules. The basic part of PLCEC2010 is ATMega16 microcontroller. Its function is to receive the sinusoidal signal from the anemometer, extract the wind speed information and send it to the central computer, via LAN network. One data acquisition module can host up to 8 analogue or digital sensors (inputs I0 to I7). Those sensors can be thermometers, carbon monoxide sensors (CO sensors), luminosity sensors, sound sensors, etc. The sinusoidal signal from the anemometer output is connected to the ADC0 input of the ATMega16 microcontroller, via two resistor voltage divider. The microcontroller performs the AD conversion every 500µs and counts positive half-period of the input signal. In order to eliminate noise influence and obtain high accuracy of the measurements, the software performs some filtering. In this sense, every 500µs, three AD conversions are performed. The maximum and the minimum value are discarded, and the middle value is further processed. The PLC-EC2010 (here ir sensor) calculates number of cuts, during time interval of one second, and sends it to the central computer. That information is then used by the PC application to calculate the wind speed. it also consist of additional features like automatic head lights on when vehicle enters into tunnel , displaying vehicle to vehicle distance and speed to be followed for safe driving.

III. DESIGN AND IMPLEMENTATION

A. Tunnel Data Acquisition In this setup the various environmental parameters like fire, wind speed, gas volume are continuously detecting and sends values to controller through fire, IR, gas sensors respectively. The controller is converts the sensed values to digital data and send to supervisory control unit through wife. And any physical parameter exceeds its normal values. Its sends the alert messages to pre defined numbers through gsm modem. In vehicle section the LDR

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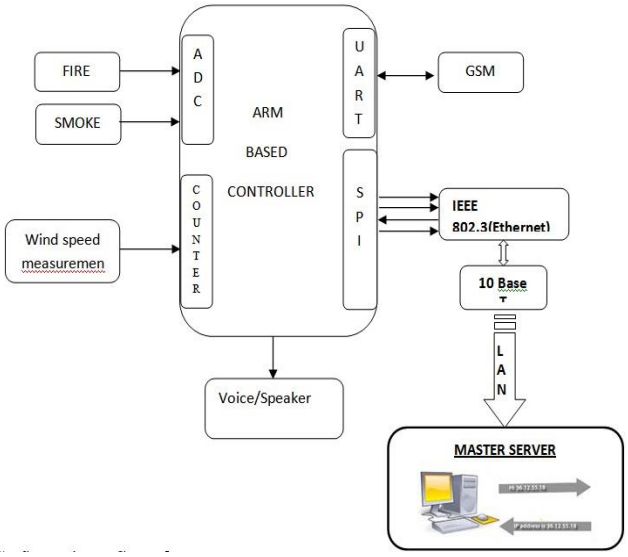
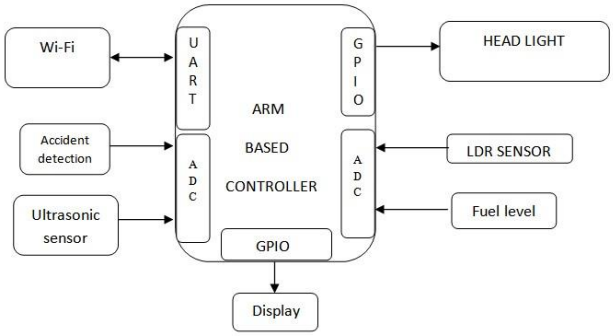
sensor gives the information about light intensity in near to car. Give this information to controller. Depending On the Sensor Output Values the car head lights on or off depends on ldr sensor output. And fuel level sensor indicates the amount of fuel remains in tank and if fuel level is low the controller gives alert. Ultra sonic sensor senses the any obstacles near the car and gives alert. And any in case of any accidents the vibration sensor sense and send these information sends to supervisory unit through wife. Through whole this setup we are monitor, control and prevent the effect of accidents and in-convince inside Tunnel due to various parameters such as (Fire, Fuel Level, Air Quality Systems, Wind flow, and Accident Detection) and to transmit these values through Ethernet for safe flow of vehicles inside Tunnels so that users can drive the vehicle accordingly. Vehicle -2-vehicle and Tunnel Grid. Air quality maintenance to prevent inconvenient to drivers, Fire and wind flow detection to predict and alert upcoming disaster Monitoring and controlling hazardous vehicle parameters and driving conditions, Smart ventilation, Automatic Headlights when vehicle enters tunnel Distance maintenance from one vehicle to other, in order to avoid congestion in tunnel, Fuel level prediction so that vehicle doesn't stop in side tunnel, Accident detection and intimation to Supervisory Control and predefined mobile number.

BLOCK DIAGRAM:



1) Tunnel Data Acquisition

2) Supervisory Control:



3) In-vehicle Embedded unit:

IV. SYSTEM HARDWARE

A. Microcontroller LPC2148 Microcontroller Architecture based on ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The ARM7TDMI-S processor has two instruction sets: The standard 32-bit ARM set.• A 16-bit Thumb set.• The Thumb set's 16-bit

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instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because Thumb code operates on the same 32-bit register set as ARM code. Thumb code is able to provide up to 65% of the code size of ARM, and 160% of the performance of an equivalent ARM processor connected to a 16-bit memory system.

The LPC2926/2927/2929 combine an ARM968E-S CPU core with two integrated TCM blocks operating at frequencies of up to 125 MHz, Full-speed USB 2.0 OTG and device controller, CAN and LIN, 56 kB SRAM, up to 768 kB flash memory, external memory interface, three 10-bit ADCs, and multiple serial and parallel interfaces in a single chip targeted at consumer, industrial and communication markets. To optimize system power consumption, the LPC2926/2927/2929 has a very flexible Clock Generation Unit (CGU) that provides dynamic clock gating and scaling.

B. GSM: A GSM modem is a wireless modem that works with a GSM wireless network. Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. Sending the Message: To send the SMS message, type the following command: AT+CMGS="+31638740161" Replace the above phone number with your own cell phone number. The modem will respond with: > You can now type the message text and send the message using the - key combination: TEST GSM ! Here CTRL-Z is keyword for sending an sms through the mobile device. After some seconds the modem will respond with the message ID of the message, indicating that the message was sent correctly: +CMGS: 62 In this paper, GSM will acts as a bi directional communication between the Querying passenger, server and the Bus section.

C. Ethernet Ethernet is a large and diverse family of frame-based computer networking technologies for local area networks (LANs). The name comes from the physical concept of the ether. It defines a number of wiring and signalling standards for the physical layer, through means of network access at the Media Access Control (MAC)/Data Link Layer, and a common addressing format. On top of the physical layer Ethernet stations communicate to each other by sending each other data packets, small blocks of data that are individually sent and delivered.

D. Different Sensors Here different sensors are used for different measures those are Fire sensor, Smoke sensor, LDR, Fuel level sensor, Ultrasonic sensor, IR and mem sensor etc.,

E. Ultra Sonic Sensor Our ultrasonic rangefinder is capable of allowing the user to determine his or her distance from an object or wall. When deciding on what type of project to design and construct, we decided that we wanted to create something that would have some practical use in life. Many groups in the past created video games, but we wanted to be different. We considered issues such as safety, user interface, and ease of use, and came up with the idea of making an ultrasonic rangefinder. A rangefinder can be used in various applications such as a measuring device or an obstacle detection device.

F. WI-Fi HLK-RM04 is a new low-cost embedded UART-ETHWIFI module (serial port - Ethernet - Wireless network) developed by Shenzhen Hi-Link Electronic co., Ltd. This product is an embedded module based on the universal serial interface network standard, built-in TCP / IP protocol stack, enabling the user serial port, Ethernet, wireless network (wife) interface between the on versions. Through the HLKRM04 module, the traditional serial devices do not need to change any configuration, data can be transmitted through the Internet network. Provides a

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quick solution for the user's serial devices to transfer data via Ethernet.

V. SYSTEM SOFTWARE

Keil compiler is software used where the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further processing. Keil compiler also supports C language code.

VI. CONCLUSION

This project main objective is to monitor, control and prevent the effect of accidents and in-convince inside Tunnel due to various parameters such as (Fire, Fuel Level, Air Quality Systems, Wind flow, and Accident Detection) and to transmit these values through Ethernet for safe flow of vehicles inside Tunnels so that users can drive the vehicle accordingly.Vehicle -2-vehicle and Tunnel Grid. Air quality maintenance to prevent inconvenient to drivers, Fire and wind flow detection to predict and alert upcoming disaster Monitoring and controlling hazardous vehicle parameters and driving conditions, Smart ventilation, Automatic Headlights when vehicle enters tunnel Distance maintenance from one vehicle to other, in order to avoid congestion in tunnel, Fuel level prediction so that vehicle doesn't stop in side tunnel, Accident detection and intimation to Supervisory Control and predefined mobile number.

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