DESIGN OF REMOTE SURVEILLANCE SYSTEM FOR DETECTION OF DRIVER'S DROWSINESS USING LOW-COST EMBEDDED PLATFORM

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Abstract: Existing camera system in the vehicles will detect the other vehicles coming from the backside of our vehicle and there is no alarm for showing that you are in danger. Moreover, if the driver is sleeping there is no intimation. To avoid such situations, we are going for a proposed system. Drowsy driving is a major problem in the road accidents. The risk, danger, and often tragic results of drowsy driving are horrible accidents and terrible deaths. Drowsy driving is the dangerous combination of driving and sleepiness or fatigue. This usually happens when a driver has not slept enough but it can also happen due to untreated sleep disorders, medications, drinking alcohol or shift work. No one knows the exact moment when sleep comes over their body. Falling asleep at the wheel is clearly dangerous. This means that a crash caused by drowsy driving might be said to have been caused by something else. After all, the scene of the crash can look the same as one caused by reckless driving or drunk driving. To avoid these conditions we are implementing our project, which is to design and develop a low cost feature which is based on an embedded platform for finding the driver drowsiness. Specifically the camera is used to capture eye movements of a driver, if the driver is not paying attention on the road ahead and a dangerous situation is detected, the system will warn the driver by giving the warning sounds through buzzer, and simultaneously the messages are sent to the registered people by the means of GSM system.

I. INTRODUCTION

With embedded systems fast expanding its reach, subject matter related to this field is available in abundance. While working on this project we have studied matter from various sources such as books, online articles and reference manuals. The knowledge gained from this activity has been of great help to us in understanding the basic concepts related to our project and has ignited further interest in this topic. “Linux for Embedded and Real time Applications”, by Doug Abbott has been of great help in providing an introduction to the process of building embedded systems in Linux. It has helped us understand the process of configuring and building the Linux kernel and installing tool chains. We understood the preponderance of the ARM processors in the field of embedded systems and the features of ARM processors from the document “The ARM Architecture” by Leonid Ryzhyk. The ARM architecture is a confluence of many useful features that makes it better than other peer processors. Being small in size and requiring less power, they prove useful in providing an efficient performance in embedded applications. Drowsiness is one of the major factors leading to car accidents, and preventing drowsy driving plays an important role in safety driving. Today, many automobile companies and
institutions have been studying ways to monitor drowsiness as a means to avoid car crashes. Physiological measurements such as electroencephalogram (EEG), electrocardiogram (ECG), spo2 etc. capturing eye closure, facial features or driving performance (such as steering characteristics, lane departure, etc.) are used for drowsiness detection. When drowsiness is detected while driving, audible sound vibrations or warning messages on a display are generally used to warn the driver to concentrate on driving or to take a rest. These methods help the drowsy driver to prevent drowsiness-related crashes in a moment, but it is hard to get rid of drowsiness by just being aware of it. For greater safety, awakening method that physiologically reduces drowsiness and acts upon the drowsy driver’s physiological condition before stronger drowsiness appears is needed. The key to overcoming drowsiness is to provide the body with a constant supply of oxygen. It is generally known that oxygen desaturation deteriorates brain activity and brings about loss of attentiveness and concentration.

II. EXISTING AND PROPOSED MODELS

Existing camera system in the vehicles will detect the other vehicles coming backside of our vehicle and there is no alarm for showing that you are in danger, and if the driver is sleeping no intimation to avoid such situations we are going for proposed system. In the existing method the main disadvantage is we are not monitoring the driver conditions physiologically. Drowsy driving is a major problem in the Road accidents. The risk, danger, and often tragic results of drowsy driving are alarming, drowsy driving is the dangerous combination of driving and sleepiness or fatigue this usually happens when a driver has not slept enough, but it can also happen due to untreated sleep disorders, medications, drinking alcohol, or shift work, no one knows the exact moment when sleep comes over their body. Falling asleep at the wheel is clearly dangerous, this means that a crash caused by drowsy driving might be said to have been caused by something else. After all, the scene of the crash can look the same as one caused by reckless driving or drunk driving. Many states do not even have a code on their crash report forms to show when a driver fell asleep. They also do not have a central database to track these causes.

To avoid these conditions we are implementing Our Embedded project is to design and develop a low cost feature which is based on embedded platform for finding the driver drowsiness. Specifically the camera is used to capture eye movements of driver, if the driver is not paying attention on the road ahead and a dangerous situation is detected, the system will warn the driver by giving the warning sounds through buzzer.

Block Diagram:
III. HARDWARE IMPLEMENTATION

A. RASPBERRY PI BOARD:

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. The Raspberry Pi is manufactured in two board configurations through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman. These companies sell the Raspberry Pi online. Egoman produces a version for distribution solely in China and Taiwan, which can be distinguished from other PIs by their red coloring and lack of FCC/CE marks. The hardware is the same across all manufacturers. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and persistent storage.

Fig. Board features

The Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with support for BBC BASIC (via the RISC OS image or the Brandy Basic clone for Linux), C, Java and Perl.

B. TFT display unit:

TFT stands for Thin Film Transistor, and is a type of technology used to improve the image quality of an LCD. Each pixel on a TFT-LCD has its own transistor on the glass itself, which offers more control over the images and colors that it renders. While TFT-LCDs can deliver sharp images, they also tend to offer relatively poor viewing angles, meaning they look best when viewed head-on. If you view a TFT-LCD from the side, it can be difficult to see. TFT-LCDs also consume more power than other types of cell phone displays.

C. UVC Driver Camera:

Fig. UVC Driver Camera
A UVC (or Universal Video Class) driver is a USB-category driver. A driver enables a device, such as your webcam, to communicate with your computer’s operating system. And USB (or Universal Serial Bus) is a common type of connection that allows for high-speed data transfer. Most current operating systems support UVC. Although UVC is a relatively new format, it is quickly becoming common.

There are two kinds of webcam drivers:

1. The one included with the installation disc that came with your product. For your webcam to work properly, this driver requires some time to install. It is specifically tuned for your webcam, designed by your webcam manufacturer and optimized for webcam performance.

2. A UVC driver:- You can only use one driver at a time, but either one will allow you to use your webcam with various applications.

D. Wi-Fi:

Wi-Fi, also spelled Wi-Fi or Wi-Fi, is a local area wireless technology that allows an electronic device to exchange data or connect to the internet using 2.4 GHz UHF and 5 GHz SHF radio waves. The name is a trademark name, and is a play on the audiophile term Hi-Fi. The Wi-Fi Alliance defines Wi-Fi as any "Wireless Local Area Network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) standards". However, since most modern WLANs are based on these standards, the term "Wi-Fi" is used in general English as a synonym for "WLAN". Only Wi-Fi products that complete Wi-Fi Alliance interoperability certification testing successfully may use the "Wi-Fi CERTIFIED" trademark. Many devices can use Wi-Fi, e.g., personal computers, video-game consoles, smart phones, some digital cameras, tablet computers and digital audio players.

These can connect to a network resource such as the Internet via a wireless network access point. Such an access point (or hotspot) has a range of about 20 meters (66 feet) indoors and a greater range outdoors. Hotspot coverage can comprise an area as small as a single room with walls that block radio waves, or as large as many square kilometers achieved by using multiple overlapping access points. Wi-Fi can be less secure than wired connections (such as Ethernet) because an intruder does not need a physical connection. Web pages that use SSL are secure but unencrypted internet access can easily be detected by intruders. Because of this, Wi-Fi has adopted various encryption technologies. The early encryption WEP, proved easy to break. Higher quality protocols (WPA, WPA2) were added later. An optional feature added in 2007, called Wi-Fi Protected Setup (WPS), and had a serious flaw that allowed an attacker to recover the router's password.

IV. SOFTWARE REQUIREMENTS

A. Linux Operating System:

Linux or GNU/Linux is a free and open source software operating system for computers. The operating system is a collection of the basic instructions that tell the electronic parts of the computer what to do and how to work. Free and open source software (FOSS) means that everyone has the freedom to use it, see how it works, and changes it.
There is a lot of software for Linux, and since Linux is free software it means that none of the software will put any license restrictions on users. This is one of the reasons why many people like to use Linux.

A Linux-based system is a modular Unix-like operating system. It derives much of its basic design from principles established in UNIX during the 1970s and 1980s. Such a system uses a monolithic kernel, the Linux kernel, which handles process control, networking, and peripheral and file system access. Device drivers are either integrated directly with the kernel or added as modules loaded while the system is running.

![Architecture of Linux Operating System](image)

**B. Qt for Embedded Linux:**

Qt is a cross-platform application framework that is widely used for developing application software with a graphical user interface (GUI) (in which cases Qt is classified as a widget toolkit), and also used for developing non-GUI programs such as command-line tools and consoles for servers. Qt uses standard C++ but makes extensive use of a special code generator (called the Meta Object Compiler, or moc) together with several macros to enrich the language. Qt can also be used in several other programming languages via language bindings. It runs on the major desktop platforms and some of the mobile platforms. Non-GUI features include SQL database access, XML parsing, thread management, network support, and a unified cross-platform application programming interface for file handling. It has extensive internationalization support.

**C. Open CV:**

Open CV (Open Source Computer Vision) is a library of programming functions for real time computer vision. It is developed by Willow Garage, which is also the organization behind the famous Robot Operating System (ROS). Now you’d say MATLAB also can do Image Processing, then why open CV? Stated below are some differences between both. Once you go through them, you can decide for yourself. Advantages of Open CV over MATLAB (Collected from various blogs/forums):

- **Speed:** Mat lab is built on Java, and Java is built upon C. So when you run a Mat lab program, your computer is busy trying to interpret all that Mat lab code. Then it turns it into Java, and then finally executes the code. Open CV on the other hand, is basically a library of functions written in C/C++.

  You are closer to directly provide machine language code to the computer to get executed. So ultimately you get more image processing done for your computers processing cycles, and not more interpreting. As a result of this, programs written in
Open CV run much faster than similar programs written in Matlab. So, conclusion Open CV is damn fast when it comes to speed of execution. For example, we might write a small program to detect people’s smiles in a sequence of video frames. In Matlab, we would typically get 3-4 frames analyzed per second. In Open CV, we would get at least 30 frames per second, resulting in real-time detection.

Resources needed: Due to the high level nature of Matlab, it uses a lot of your systems resources. And I mean A LOT! Matlab code requires over a gig of RAM to run through video. In comparison, typical Open CV programs only require ~70mb of RAM to run in real-time. The difference as you can easily see is HUGE!

Cost: List price for the base (no toolboxes) MATLAB (commercial, single user License) is around USD 2150. Open CV (BSD license) is free!

Portability: MATLAB and Open CV run equally well on Windows, Linux and Mac OS. However, when it comes to Open CV, any device that can run C, can, in all probability, run Open CV.

V. RESULTS

Fig : Face Detection

Fig : Execution Results of Face Detection.

Fig: Execution Results of Eye Detection using Qt Creator.

VI. CONCLUSION

The project “Remote Surveillance System for Driver Drowsiness in Real-time Using Low-cost Embedded Platform” has been successfully designed and tested. It has been developed by integrating features of all the hardware components and software used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced ARM board and with the help of growing technology the project has been successfully implemented.
REFERENCES