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Traffic Sign Recognition For Computer Vision Project-Based Learning

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Abstract:
Our system is designed by using ARM 32-bit micro controller which supports different features and algorithms for the development of automotive vision systems. Here the camera is connected to ARM controller. The camera will capture traffic sign & colors and send the information to controller. While driving if any accident objects is present, the objects can be detected by using ultrasonic sensor which is connected to ARM board. The controller will recognize the signs using Open CV libraries and it will detect objects using sensor, based on this controller will perform particular operation like stop the vehicle etc. Also it displays the information on touch screen display unit.

I. INTRODUCTION

Computer vision (CV) is a subfield of artificial intelligence (AI) aimed at understanding still images and video sequences; examples of this include recognizing people or objects, navigating in an environment, reconstructing the three dimensional shape of a scene, or controlling a device (such as when a robotic arm grasps an object). It is an interdisciplinary field that draws from computer science, signal processing, and a number of mathematical field like geometry, statistics, and algebra. During the last two decades, CV has progressively been incorporated into both undergraduate and graduate programs of computer science studies. In their excellent review on CV education, Bebis et al. [2] review various approaches to teaching CV. Most of the literature is focused on different approaches to integrating the topic into undergraduate courses. The most common approach is to follow the traditional course structure in which the students are presented with theoretical lectures and have short practical assignments. Another approach is to use student's specific knowledge in a given area (computer graphics, image processing, etc.) and then introduce the new CV concepts on top. This approach assumes that the students already have knowledge of a given topic, which is convenient for undergraduate studies in which students have to follow a given subject itinerary. Another interesting method for teaching CV is through interactive technology. As an example, Reimer *et al.* [3] propose tangible interface that accelerates the process of understanding the components and results of a vision system for students who have little experience in programming. However, while this can be a convenient approach for undergraduate students, being able to program and optimize the algorithms is a compulsory skill for a graduate student. Another widely used approach is to integrate the study of computer vision with another related topic, for example fusing robotics and CV in the same course [4]. Similarly, However [5] proposes introducing computer vision topics into an undergraduate embedded systems course. In order to attract students to the field, the introduction of image computation in early programming classes has been proposed [6]. Finally, one attractive approach to having the students learn the topic is by having them carry out a CV project that solves a given problem. This methodology, usually referred to as project-based learning (PBL), has been used in secondary-level studies [7], engineering courses [8]–[14], and also graduate courses [15], this last one being an entry-level project like the one presented here.PBL has several advantages over the other approaches.

- It allows the students to gain real experience in a topic.
- It brings together theoretical and practical concepts with a Single goal, which enhances students' motivation.
- It allows the students to discover these new concepts for themselves if the course is

well designed. Furthermore, PBL suits both undergraduate courses and graduate courses in which the concepts are more advanced and specialized.

II. HARDWARE IMPLEMENTATION

A. A. MINI6410 Board

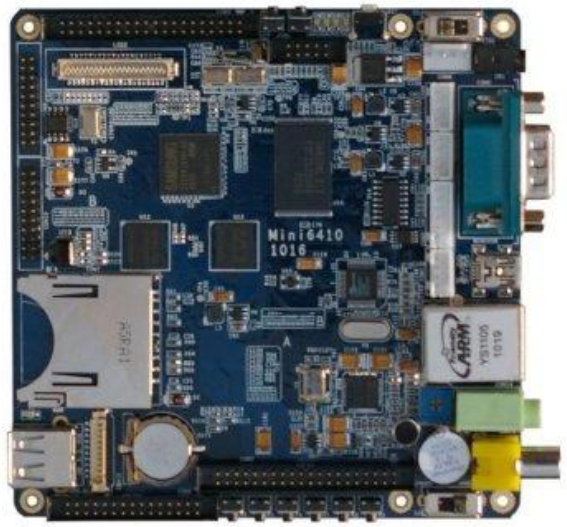


Fig1. MINI 6410 Development board

The S3C6410 Board is a compact full-featured Embedded Single Board Computer (SBC) based upon Samsung ARM11 S3C6410, designed specifically for Mobile Internet Device, Notebook, handheld/3G mobile implementations. Its functional contents are similar to the latest generation of Pocket PC's and smart phones. This computer allows easy embedded application development through PC-Compatible tools and methods, while ensuring in-field reliability and ruggedness for end-user systems S3C6410 runs without fans or heat sinks in the temperature range of -20°C to +70°C. Other chip-level features include 4 UARTs, SPI, and I2C, a real-time clock with a separate power domain, and NAND Flash and DDR memory controllers. These features make the devices particularly suitable for automotive and industrial control applications as well as medical systems. In addition, the board supports Windows Embedded CE 6.0, Linux2.6, Android and Ubuntu OS.

B. UVC Camera Driver

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.

Fig2. UVC Driver Camera

Most current operating systems support UVC. Although UVC is a relatively new format, it is quickly becoming common.

C. Ultrasonic Distance sensors

These sensors are pretty simple. In theory that is. In practice these sensors can be a real pain in the pinky. In this section I'll cover some of the troubles you may run into when trying to get them to work.
Ultrasonic distance sensors consist of 3 major parts: A transmitter, a receiver and a timer. To measure a distance the timer triggers the transmitter which emits a series of pulses, then the timer waits until the receiver detects the reflection of the pulses and stops the timer. The time measured is then divided by 2 and multiplied with the speed of sound. The result is the distance between the sensor and the object in front of it. The transmitter sends out a stream of pulses on a carrier frequency. The maximum frequency humans can hear is about 20 KHz. A frequency higher than that is picked to avoid annoying humans with the constant beep -- 40KHz is a common value

D. DC MOTOR

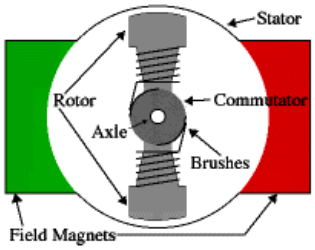


Fig3. Motor

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from

playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

III. 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.

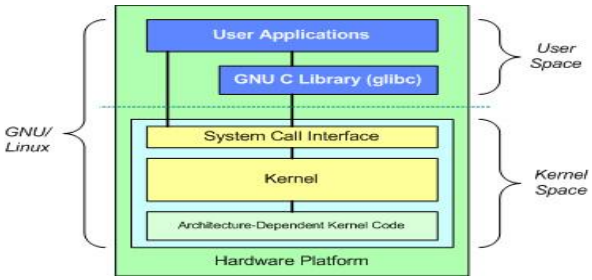


Fig4. Architecture of Linux Operating System

B. Qt for embedded Linux

Qt for Embedded Linux is a C++ framework for GUI and application development for embedded devices. It runs on a variety of processors, usually with Embedded Linux. Qt for Embedded Linux provides the standard Qt API for embedded devices with a lightweight window system.

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 OpenCV over MATLAB (Collected from various blogs/forums):-

- Speed: Matlab is built on Java, and Java is built upon C. So when you run a Matlab program, your computer is busy trying to interpret all that Matlab 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 analysed 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.

IV BLOCK DIAGRAM

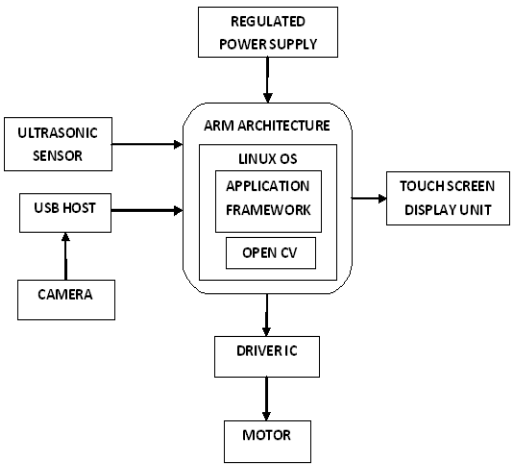
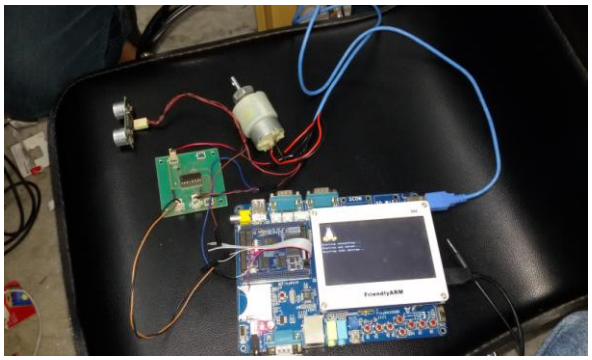
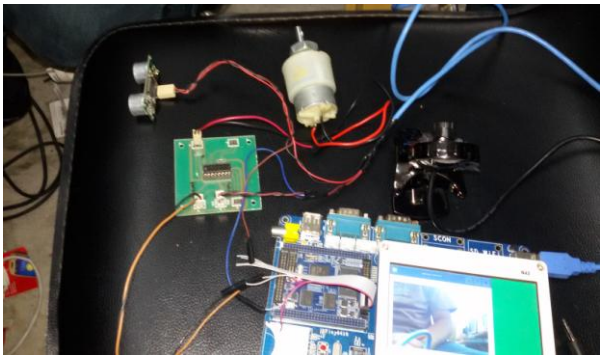


Fig5. Implementation Block Diagram

In this system, the **ARM 32-bit** micro controller which supports operating system acts as core unit performing two tasks i.e., the camera captures the traffic sign signal and displays the same on the touch screen display unit inside the vehicle. Secondly the ultrasonic sensor and motor are used to avoid the accidents. The sensor senses the signal from the vehicle and passes the information as input to the motor. So, that if any vehicle identifies automatically the motor stops.

VI. RESULTS





VII. CONCLUSION

The project "TRAFFIC SIGN RECOGNITION FOR COMPUTER VISION PROJECT-BASED LEARNING" 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 ARM9 board and with the help of growing technology the project has been successfully implemented.

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