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Raspberry-Pi Based Road Sign Recognition And Automatic Headlight Dimming Systems with Vehicle Collision Avoidance Using Image Processing

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ABSTRACT: Human beings like enjoying their life, and that's why they invented and created the vehicles. But towards enjoying their environment, they suffer with accidents and lose valuable lives and properties. For avoiding rash driving of the drivers and from accidents, the system has designed with the help of two main controllers Raspberry pi and PIC microcontroller. The Digital image processing takes major place in a road sign recognition system. The system reads and recognizes the speed signs using image processing techniques based on shape and dimension analysis. During night time travels the system can easily identified the road signs by colour shape detection. Raspberry pi processor provides an interface between sensors, database and image processing results. Apart from this an another unit i.e. the PIC controller unit gives a major play to the vehicle by controlling the small signaling parts, which may cause to an major issue in future for example puncher of tires, headlight failures etc. To avoid these issues while driving, the indication of tire pressure is done displayed in the screen and the headlight dimming is controlled by the use of LDR sensor. As well as, in addition to this system have added the control of motors through ultrasonic sensors which are very helpful to avoid accidents and it maintains a gentlemen distance to the fronted vehicles. Hence through this, the performance of the vehicle is controlled automatically according to the situation**.**

KEYWORDS: Digital Image Processing, Raspberry Pi, Road Sign recognition, LDR sensor, PIC microcontroller, ultrasonic sensor, pressure sensor

I.INTRODUCTION

In the time of road way travelling the peoples can suffering on many accidents for driver's carelessness to detect the road signs. Instead of avoid these problems to design the automatic road sign recognition system using raspberry pi processor. The system can help the driver to detect the road signs and automatically reduce the vehicle's speed. This system also increasing the passenger safety during travelling time. The mini embedded computer (Raspberry pi) having many port connections to interface the external devices.

The headlight requirement is necessary for night time travel. But now a day the headlight system is responsible for many accidents. The drivers have the control of headlight switching system which can be switched from high beam (bright) to low beam (dim). But in some time the drivers does not switched the headlight system it can be create the temporary blind spot for oncoming vehicles at the particular time involuntary closing the driver's eyes. This phenomenon is the main reason for road accidents at night time. To avoid these type of accidents to design the automatic automobile headlight switching system. The designed system can be easily switched from high beam(bright) to low beam(dim). The LDR based electronic circuitry arrangement which senses the illumination of light from oncoming vehicles to perform the switching operation.

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The vehicle collision avoidance system is combined with the above systems. It is also a vehicle safety system. It should be designed to avoid the collision of two vehicles in same direction. It is also known as precrash system. The ultrasonic sensors are fixed in front of the vehicles. To approaching the sensed data through database if any vehicle going in front of our vehicle means immediately applying the automatic breaking system during this situation our vehicle cannot entering into the 10 feet distance.

Additionally the tire pressure measurement system is also combined with the above systems. Now a day the drivers must be checked the tire pressure is done by manually. So the system was designed to check the tire pressure automatically. The pressure sensor senses the current tire pressure value and given the notification on the LCD display to view the drivers lagging.

II.PROPOSED METHOD

The proposed system has been used the PIC 16F877A micro controller for vehicle collision avoidance system and automatic headlight switching system. PIC 16F877A this is works based on the RISC instruction set. Additionally the tire pressure measurement system is combined with the above processor to avoid the circuit complexity and achieve more operations through a single processor.

The general block diagram of a proposed system is shown in **Figure 1**. The raspberry pi processor and PIC controller are combined with a switching network. So the user can be manually controlled the switch to achieve which operations it should be performed. These two processors are having lightweight techniques so both processors can be used easily in real time application.

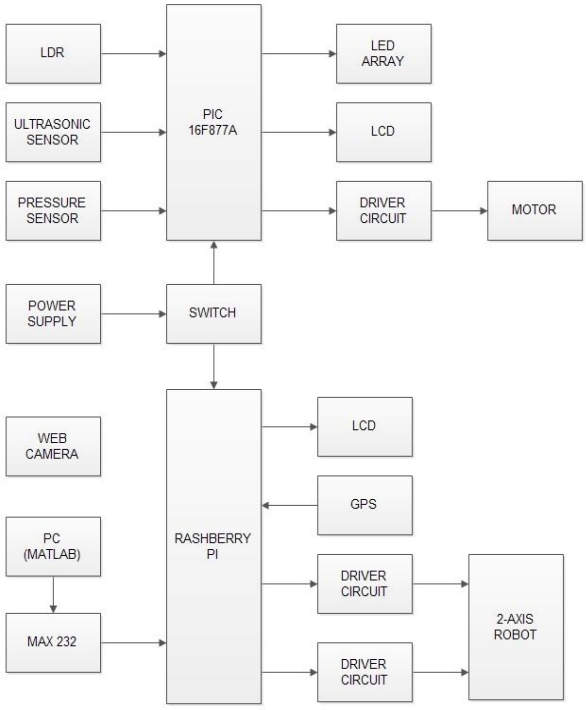

Figure 1.General block diagram

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A.**ROAD SIGN DETECTION AND RECOGNITION SYSTEM**

Raspberry Pi is a small sized single board embedded computer developed by Raspberry Pi Foundation. The Raspberry pi is mainly depended on Broadcom BCM2837 System on Chip (SoC) with core architecture of 32-bit quad-core ARM Cortex-A53 processor having an operating frequency of 900MHz as shown in **Figure 2.** The B model has a memory of 1 GB LPDDR2 SDRAM, 40 GPIO pins, 4 USB-2.0 ports, one Ethernet socket, video output, audio output, with a microSDHC slot

The Raspberry pi processor using has power consumption of 5v, 2A. The operating system boots from micro SD card with a current version of Linux operating system such as Debian, Raspbian and Fedora etc. The basic software tool required for Raspberry pi is OpenCV with any of the programming language like C/C++, python, Java, Ruby and Pearl.

The Raspberry pi video controller port gives the high resolution HD images but it does not have the real time clock. So it cannot be display the current day and time.

Raspberry pi is capturing the road signs using web camera module. The captured signs are processed by a JPEG encoder which result gives the resized signs suitable for image processing results.

Figure 2. Raspberry pi 3 model B

The image processing section having four categories of road sign identification units:

I. Mandatory signs: These types of signs are always available in a round shaped with red border.
II. Cautionary signs: These types of signs are always available in triangular shape with red border.
III .Information signs: These types of signs are always available in square shape with blue border.
IV. Additional signs: All the signs except for the above types of codes known as additional signs.

The above types of captured signs are in rapidly bandwidth. So the limitation of bandwidth using the multithreading technique is the first step for preprocessing algorithm. After that the system considering another factor is synchronization. This factor using Global Interpreter Lock (GIL) too difficult in python compared to low level languages in multithreading.

The captured sign is processed which is suitable for above for classification of signs. It is co incident for mandatory, additional signs and information signs it is shown in **Figure 3**. Which means the system given the warning signal to driver or otherwise the sign co-incidents with the cautionary means immediately applying the Automatic Breaking System(ABS) to reduce the speed of the vehicle up to notified value. After crossing the restricted area the automatic breaking system can be released their force to help increasing the speed of the vehicle. When the vehicle entering into the

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restricted zone immediately the automatic breaking system can easily triggered into ON state at the same time the driver can be operated at the manual breaking system is also possible.

The edge detection technique is used to detect the signs and converted into binary format. Here canny edge detection system is guided by the sign detection system. The Adaboost algorithm gives the supervised pattern recognizing system to enhance the input recognition procedure to weak classified detected signs.In most of the road sign image quality is improved by the open source optical character recognition engine.

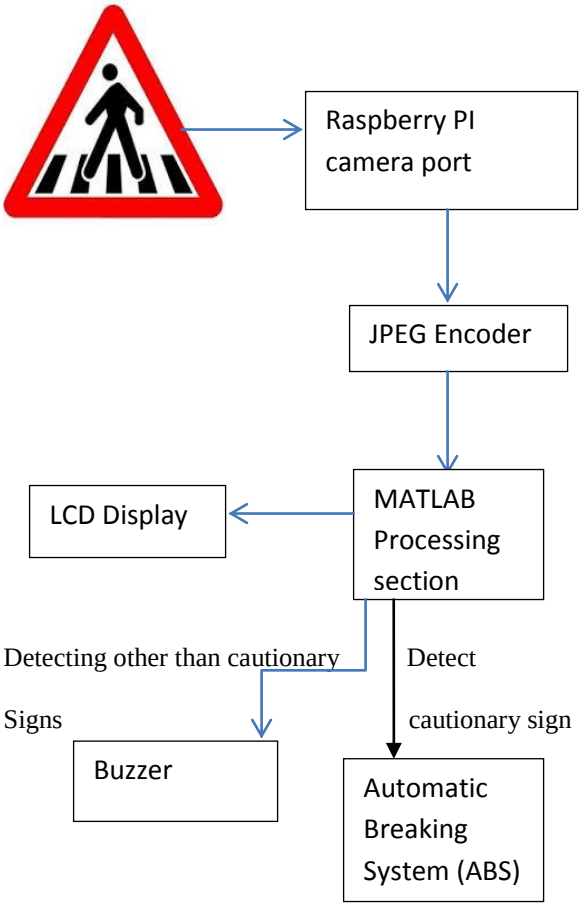

Figure 3. Raspberry pi based sign detection

B. AUTOMATIC HEADLIGHT SWITCHING SYSTEM

The effect of high illumination to create the glare for oncoming vehicles. So this system was design by the switching network with LDR is shown in **Figure 4.**

The sensing network (LDR) is fixed in front of the vehicles and this network are connected with the headlight switching circuit to LDR. When the vehicles are coming in the opposite direction to give the high illumination (high beam) to our vehicle during running time at the same time LDR detect the high beam signal and it gives to the switching network. This network can be switched the signal in high beam to low beam.

PIC microcontroller unit gives the instruction to the LDR circuit via PORT A I/O operation buses. The two resistors are combined with the Light Dependent Resister (LDR) from the potential divider network. They are used as

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potential divider network to control the current flow to the processor. Both resisters depend on the LDR when no current flows into the loop in the dark

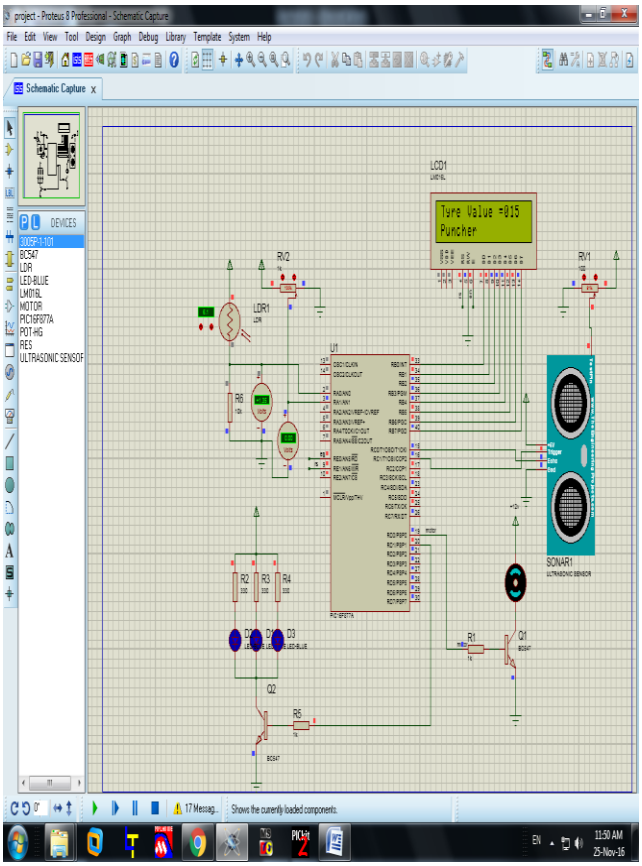

Figure 4. Operation of LDR and ultrasonic sensors

C. VEHICLE COLLISION AVOIDANCE SYSTEM

In the above Figure 4 shows the operation of ultrasonic sensor for vehicle collision avoidance system

The ultrasonic sensors are worked with in 2cm to 3m it is shown in **Figure** 5. It likes a transducer to convert the sound wave into electrical signal. These sensor networks are fixed in front of the vehicle. When the sensor detects the obstacle in front of our vehicle at the time sensor get the sound waves. This signal is converted into an electrical signal after that the signal is given into the PIC microcontroller circuit. The processor is triggered to automatic breaking system.

The ultrasonic sensors are primarily to generate the sound waves with itself. After that the sensor emit the sound waves into an open space now any obstacles are available in the road the sound wave can be reflected. The reflected signal is received by the ultrasonic receiver.

Their processor can easily connect handling the vehicle security system due to the warning signal of ultrasonic sensors.

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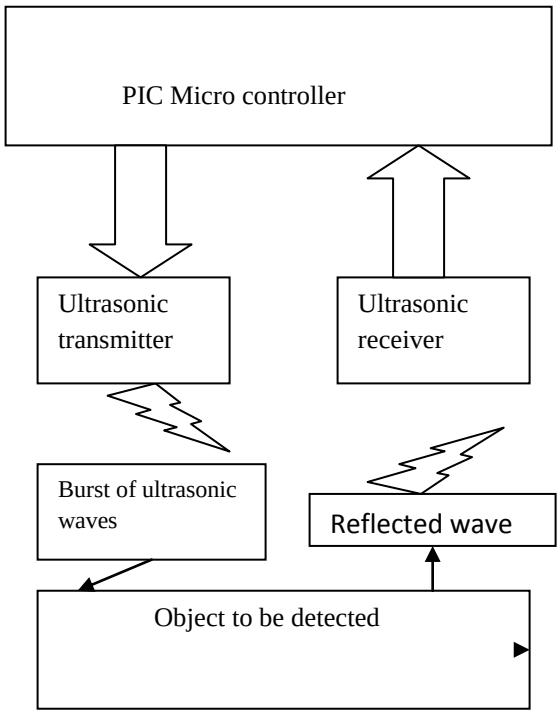

Figure 5. Operation of ultrasonic sensor

D. TIRE PRESSURE MEASUREMENT SYSTEM

The pressure sensors are used to measuring the current pressure level of tires. This sensors fixed inside the pneumatic wheels

In this system designed direct Tire Pressure Measurement System (TPMS) employ pressure sensors fixed on each wheel, either internal or external. This sensing equipment's having the transmission medium with itself. Any causes occurred in the tire suddenly the system can be easily given the notification for driver through the PIC microcontroller unit via PORT D as shown in Figure 4.

Due to the instruction based output signal is controlled the Automatic Breaking System in our vehicle

III.CONCLUSION AND FUTURE WORK

The proposed work is split into two parts, similar to other applications in the field, as "detection" and "recognition". The detection part were used the colour based segmentation to replace the shape based segmentation. The non-parametric kNN algorithms are used to perform the good recognizing system. In the future work can designed Hough transform, and artificial neural networks based algorithms. The Raspberry pi processor implemented focused on real-time video processing, however, for future work, the use of car's dynamics (direction, trajectory, speed changes etc.)

The video capturing mode is activated by a raspberry pi processor itself it should be replaced the LTE based design is also acceptable for the basic road sign video mode capturing with good colour enhancement algorithms.

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