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Obstacle Detection On Railway Track For Avoiding Accidents

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ABSTRACT

In this paper, a new type of autonomous train is developed. The localization system is constructed with GSM device. Currently tasks including object tracking, Autonomous train stop, Digital image processing, Hough transform, Optical flow, object detection, and obstacle avoidance, has been implemented on this platform. Developing on-board automotive driver assistance systems aiming to alert driver about driving environments. Such systems take actions to avoid accidents. In railway scenarios a camera in front of the train can aid drivers with the identification of obstacles. Image processing is used to detect the obstacle. we have to used two strategies for the detection of obstacles first strategy is a simple-frame-based approach for the every image frames The second approach uses consecutive frames for detecting the trajectory of moving object.

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I. INTRODUCTION

Safe autonomous driving is a huge technical challenge which still lacks general solution. Researches had explored different artificial vision methods for implementing automatic driving algorithms but many issues like changing lighting, changing background, process speed, etc., turns this problem into a complex task. Autonomous train driving is a particular case where the previous problems are present too but where the specific characteristics suggest the use of different methodologies for the design and implementation of vision algorithms.

We create a first approximation to the solution of detecting both fixed and moving objects in a railway system. Our intention was to explore different techniques for creating a system capable of warning a driver about possible threats in the route. We employed two complementary approaches for detecting and tracking the objects.

The first strategy detects the rails and scans the area near them in a bottom-up way searching for possible obstacles. This method was effective in detecting fixed objects in front the train and obstacles just near the rails. The second approach is based on the optical flow between frames. Discarding background moving elements our algorithm finds candidate dangerous objects, tracks their trajectories and foresees their paths for determining if exist a course to collision. This method has the advantages of warn with anticipation when an object could pose danger to the safety of the train.

System diagram for obstacle detection

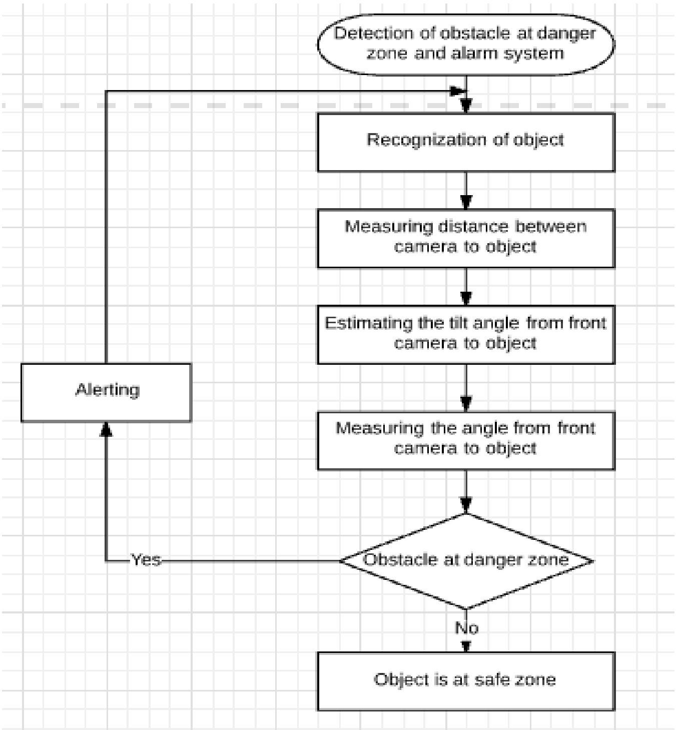


Fig. 1 flow diagram of proposed system

In this system microcontroller and the camera for Image processing are the main elements. Along with these there are a motor, a buzzer, an LCD display, Camera and a GSM modem. The two motors are connected in the Motor Driver Ic.at the appropriate places to detect the obstacle . They are connected to the microcontroller by using connecting wires. The block diagram of the system is shown in the Figure .Image processing perform the most important role for detecting obstacle on railway track by using background subtraction algorithm. When the object is detected on railway track Immediately the controller will activate the buzzer system to alert the driver and the near railway station.

II. BLOCK DIAGRAM

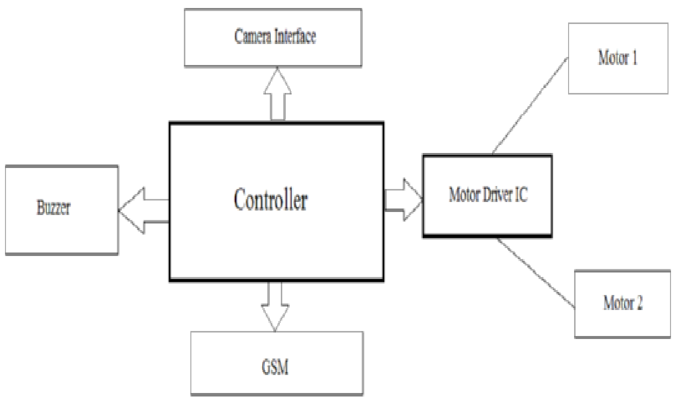


fig 2. Block diagram

OBJECTIVE

To provide the train driver an automatic aid system could alleviate the effort required and contribute with the safety of the transportation system. Detect the obstacle successfully by using image processing switch on the buzzer perform the action on railway engine.

III. METHODS

A. Python

Python is a open source programming language .Python is a interpreter language. Python is used by hundreds of thousands of programmers and is used in many places. Sometimes only Python code is used for a program, but most of the time it is used to do simple jobs while another programming language is used to do more complicated tasks. Python is a widely high level programming language for general purpose programming. Python has a designed such that it emphasizes code readability and a syntax that allows programmers to express concepts. It provides constructs that enable clear programming on both small and large scales.

B. Image Processing

Image processing is the computer algorithm which is used to perform a image processing to the digital image. digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions digital image processing may be modeled in the form of multidimentional system.

Consider this equation

Gx, y = T{ fx, y }

In this equation,

Fx, y = input image on which transformation function has to be applied.

Gx, y = the output image or processed image.

T is the transformation function.

This relation between input image and the processed output image can also be represented as.

s=Tr

where r is actually the pixel value or gray level intensity of fx, y at any point. And s is the pixel value

or gray level intensity of gx, y at any point.

C. Raspberry Pi

Raspberry Pi is a dynamic microcontroller that is capable of just about anything a computer is. It runs with the Python programming language, and is a great way to learn about hardware hacking and coding. Raspberry pi is a series of small single board computer.

The Raspberry Pi 3 uses a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache. The Raspberry Pi 3, with a quad-core Cortex-A53 processor, is described as 10 times the performance of a Raspberry Pi 1. Raspberry Pi 2 includes a quad-core Cortex-A7 CPU running at 900 MHz and 1 GB RAM.

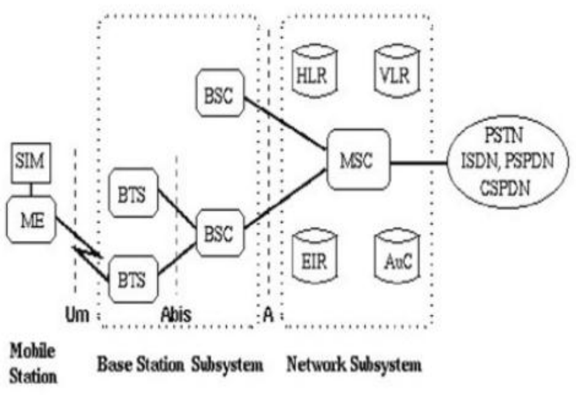
The Model A, A+ and Pi Zero have no Ethernet circuitry and are commonly connected to a network using an external user-supplied USB Ethernet or Wi-fi adapter. On the Model B and B+ the Ethernet port is provided by a built-in USB Ethernet adapter using the SMSC LAN9514 chip. The CPU chips of the first and second generation Raspberry pi board did not require cooling , such as a t sink, unless the chip was overclocked, but the Raspberry pi 2 SoC may heat more than usual under overclocking.

D. ***GSM* module**

GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services. GSM differs from first generation wireless systems in that it uses digital technology and time division multiple access transmission methods. GSM is a circuit-switched system that divides each 200kHz channel into eight 25kHz time-slots.

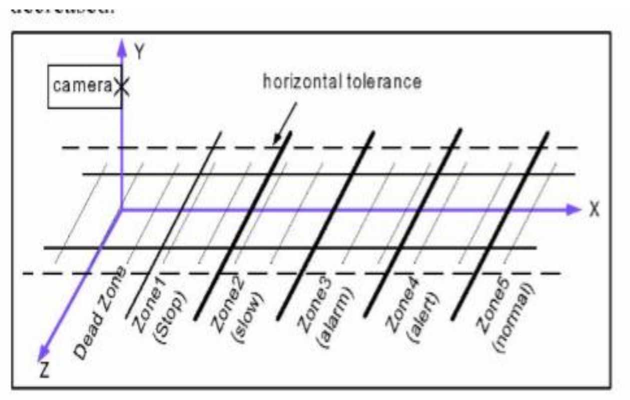
GSM supports data transfer speeds 9.6 kb/s, allowing the transmission of basic data services such as SMS (Short Message Service). GSM satellite roaming has also extended service access to areas where terrestrial coverage is not available. The transmission power in the handset is limited to a maximum of 2 watts in GSM850/900 and 1 watt in GSM1800/1900.

Architecture of GSM



SIM- Subscriber Identity Module
ME-Mobile Equipment
BTS- Base Transceiver Station
BSC -Base Station Controller
MSC- Mobile Service Switching Center
HLR- Home Location Register
VLR- Visitor Location Register
EIR- Equipment Identity Register
AuC- Authentication Center

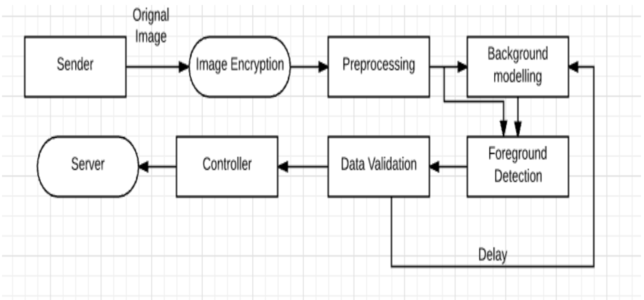
Camera Co-ordinates in the real word



ALGORITHM

Background subtraction, also known as foreground detection, is a technique in the fields of image processing and computer vision wherein an image's foreground is extracted for further processing (object recognition etc.). Generally an image's regions of interest are objects (humans, cars, text etc.) in its foreground. After the stage of image preprocessing object localisation is required which may make use of this technique. Background subtraction is a widely used approach for detecting moving objects in videos from static cameras. The rationale in the approach is that of detecting the moving objects from the difference between the current frame and a reference frame, often called "background image", or "background model". Background subtraction is mostly done if the image in question is a part of a video stream. Background subtraction provides important cues for numerous applications in computer vision, for example surveillance tracking or human poses estimation.

Background subtraction is generally based on a static background hypothesis which is often not applicable in real environments. With indoor scenes, reflections or animated images on screens lead to background changes. Similarly, due to wind, rain or illumination changes brought by weather, static backgrounds methods have difficulties with outdoor scenes.



Using frame differencing

A motion detection algorithm begins with the segmentation part where foreground or moving objects are segmented from the background. The simplest way to implement this is to take an image as background and take the frames obtained at the time t, denoted by I(t) to compare with the background image denoted by B. Here using simple arithmetic calculations, we can segment out the objects simply by using image subtraction technique of computer vision meaning for each pixels in I(t), take the pixel value denoted by P[I(t)] and subtract it with the corresponding pixels at the same position on the background image denoted as P[B].In mathematical equation, it is written as:

$$P[F(t)] = P[I(t)] - P[B]$$

The background is assumed to be the frame at time t. This difference image would only show some intensity for the pixel locations which have changed in the two frames. Though we have seemingly removed the background, this approach will only work for cases where all foreground pixels are moving and all background pixels are static. A threshold "Threshold" is put on this difference image to improve the subtraction (see Image thresholding).

$$|P[F(t)] - P[F(t+1)]| > \mathrm{Threshold}$$

This means that the difference image's pixels' intensities are 'thresholded' or filtered on the basis of value of Threshold. [4] The accuracy of this approach is dependent on speed of movement in the scene. Faster movements may require higher thresholds.

Mean filter

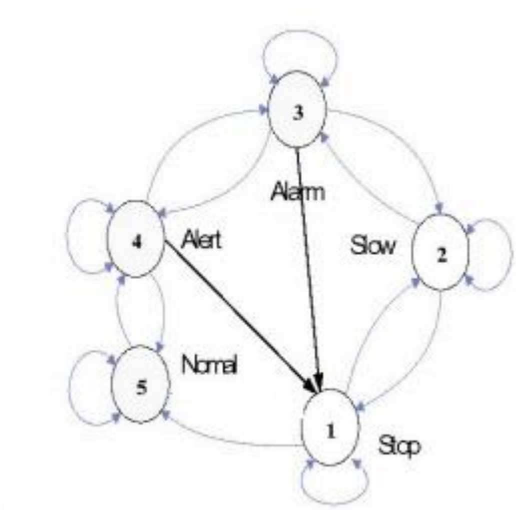
For calculating the image containing only the background, a series of preceding images are averaged. For calculating the background image at the instant t,

$$B(x,y,t) = \frac{1}{N}\sum_{i=1}^{N} V(x,y,t-i)$$

where N is the number of preceding images taken for averaging. This averaging refers to averaging corresponding pixels in the given images. N would depend on the video speed (number of images per second in the video) and the amount of movement in the video.[5] After calculating the background B(x,y,t) we can then subtract it from the image V(x,y,t) at time t = t and threshold it. Thus the foreground is

$$|V(x,y,t) - B(x,y,t)| > \mathrm{Th}$$

State Transition Diagram:



Where,
1=Stop zone
2=Slow zone
3=Alarm zone
4=Alert zone
5= Normal zone

According to the basic concept, we divide the obstacle tracking function into four steps -The train has to stop in order to avoid obstacle collision we divide the area in front of the train into four zones for appropriate control. Stop Zone(1) : Zone is most close to the train. In case an obstacle exists in this zone, the train has to stop suddenly. Slow Zone (2) : Zone is an area that crosses minimum line for braking. When the driver detects an obstacle, he affords to handle brake. Alarm Zone(3) : This zone is for monitoring an obstacle located in this area. The driver has to prepare for brake in case its location becomes in Zone 2 and 1. Alert Zone (4) : This is most far zone that driver starts to recognize object as obstacle, and be alert for both static and dynamic obstacles.

IV. LITERATURE SURVEY

A.Video based system for railroad collosion warning

In this paper system is for avoiding accident without human supervision by two methods. The first simple frame based approach where every frame is analysed using Hough transform for detecting rails. and the other is consecutive frames for detecting trajectory of moving object. they have also used chroma key effect.

B. An obstacle detection system for automated trains

The author used clothoids segments for the rail detection in each segments several algorithm are used for detecting obstacles. these included discontinuities in the line(rails),gray scale variability between adjacent segment ,optical flow between video frames. and statistic of textures in the segment.

C. Video based obstacle tracking for automatic train navigation

Obstacle existing on railway and moving towards railway in order to determine control state such as sudden break, gradual break, alarm and so on the tolerance for safe running is firstly determined due to the train speed ,the train would be suddenly stopped, homed according to the location of static obstacle. in case of dynamic that is moving to train running zone ,trajectory obstacle is estimated ,and train control state is prior consider in order to keep train from crashing.

D. Vision based railroad track extraction using dynamic programming

Dynamic programming is used in order to extract the rail and the area between them but the obstacle detection problem is not considered .calculating the image gradient using the sobel operation the near driver segments of the rails are extracted .after that the Hough transformation is employed for estimating the rails vanishing point and delimiting the area enclosed by the rails . The remaining segment in the upper part of the image are treated in a recursive way.

V. ACKNOWLEDGMENTS

I would like to take this opportunity to express my profound gratitude and deep regard to my guide Prof. Guide Name for his exemplary guidance, valuable feedback and constant encouragement throughout the duration of the project. His valuable suggestions were of huge help throughout my project work. His perceptive criticism kept me working to make this project in a much better way. Working under him was an extremely knowledgeable experience for me.

VI. CONCLUSION

This paper proposed a method of obstacle tracking for autonomous train for avoiding accidents on railway track. The dynamic as well as static obstacle can be detected on track using image processing algorithm. Two related challenges were considered:

1.Detection of fixed or moving obstacles on the rails or in the near area.
2.Detection of moving obstacles far from the rails and in a route to collision.

Both tasks are highly complex and current research topics. Particularly the detection and tracking of moving obstacles has many difficulties due to the high speed motion, the dissemination of forms (blurring) and the changing nature of the background which greatly complicates its extraction.

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