

Virtual Aerial View Projection of Vehicular Surrounding

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Abstract—For vehicle surround view systems, we suggest a new camera arrangement where the best depth measurements, not visualisation, are used to determine how the camera mountings should be placed. A significant area of research in parking help applications is the 360-degree vehicle surround view monitoring system, which is now being sold by many of the world's top automakers. Four fisheye cameras are utilised in the bird's eye view vision system to circumvent obstruction brought on by the vehicle itself. Inexperienced drivers still struggle with parallel and vertical parking even with the aid of the surround vision monitoring system, despite it being a very beneficial system for backing up assistance and parking assistance.

Index Terms— Surround View System, FOV, Depth Measurements.

I. INTRODUCTION

A vehicle's ability to drive and manoeuvre safely depends on being aware of its surroundings. Maps or surrounding information can be useful in studies of driver behaviour and in the creation of efficient driver aid systems. The automotive surround vision camera system is a newly designed ADS technology that helps the driver safely park the car by enabling top-down viewing of the entire 360-degree environment of the vehicle [1]. Technology advancements in the fields of electronics and signal processing are also being included into the automobiles produced today. Electronic actuators are now used to regulate a sizable portion of vehicle functions. This is the situation with, for instance, fuel valves, brakes, opening and closing doors and windows, etc. Additionally, the majority of vehicles equipped with an on-board computer that keeps track of all the vehicle's parameters—including speed, fuel level, range, etc.—and alerts the driver to any potential hazards. Driving Assistant Systems, or DAS, are all those devices that aid drivers and make driving safer. The Advanced Driving Assistance Systems are a new collection of technological developments for the car industry (ADAS). This team contains attempting to cut systems that provide the driver with direction.

Among others, lane departure alerting, which warns the driver when any wheel crosses a lane delimiter line, parking assistant ultrasound systems, which alerts the driver when the rear distance to an object is below a predetermined limit, and trac assistance, in which the vehicle detects and decodes trac signals, are some examples that are well-known. This research will concentrate on the ADAS: 360 vision system in particular. These tools give the driver a top-down or bird's-eye perspective of the area around the vehicle, enabling them to see through blind spots. The most typical configuration consists of numerous cameras positioned all around the car, together with a display that allows the driver to see a composite picture created from the camera data. Bird's eye systems, often known as 360-degree vision systems.

Advanced Driver Assistance Systems (ADAS) in vehicles use straightforward perspective transforms to merge images of the scene as seen from the side, front, and rear viewpoints into a synthetic top-view image. We propose a better camera setup for automotive surround view systems in which we demonstrate that it is possible to perform 3D reconstruction in practically the entire area around the car using unique algorithmic processing. Four cameras are needed to achieve this, and the positions must be carefully chosen. In order to sew the four views together, an analysis of the proposed configuration's field of view overlaps is conducted.

We found out that conventional cameras weren't able to provide the field of view required for the overlaps, hence fisheye or wide angle cameras are used in our module and the video feed from these cameras are fed to our software which uses OpenCV (open source computer vision) for Local Invariant Descriptor Detection, feature extraction and Collaboration. Our System uses four orthogonally-placed fisheye cameras, for calibrating a top-view image, in which objects and off-the ground points are accurately represented. The result image is then shown on a display on the driver's dashboard aiding him/her in parking and traffic situations. Existing Systems are closed source and expensive. Our agenda is to provide the same technology at a minimal price.

II. LITERATURE REVIEW

The traditional automatic parking system has been using ultrasonic sensors. One of the parking assistance applications based on ultrasonic sensors is Park4U®, which Valeo first put to use in 2007. Park4U® has the ability to automatically find parking spaces using an ultrasonic sensor and supports both parallel and back parking via auto steering [1].

A experiment displaying the image from the rear-view camera during autonomous parking has been conducted to reduce the driver's workload. Toyota debuted the Intelligent Parking Assist System (IPAS) with the rear view camera to the public in its Prius vehicle in 2003. IPAS offers both parallel and back parking by auto steering operation and allows the driver to select the parking target position by moving a cursor while watching the monitor [3].

Multi-camera system is made up of four close-range cameras. One camera faces forward, the other backward, and the two side cameras are built into the exterior rearview mirrors. They each have a 190-degree aperture and capture the entire environment around the vehicle. An ECU is also included in the system, which combines the camera images to form a 360-degree view and, if desired, combines them with distance information from ultrasonic sensors [4].

Similar parking detecting technology was put out by Jung et al., which gave the driver the option between two parking lot entrances. Both the computation and the accuracy of the detection were enhanced. Although the approach had an accuracy rate of over 90%, it was ineffective when there was white line detecting noise, sunlight, or the driver's reaction to touch panel operation [6].

To give drivers a complete 360-degree view with no blind spots, surround view systems have recently been launched to the market. A virtual image from the air that shows the environment around the vehicle up to a specified distance is provided by surround view systems. Four cameras are used to collect the input images, which are corrected for fisheye distortion. The undistorted images are then converted into bird's-eye view images, which are then used to build the self-driving vehicle's field of view [5].

III. METHODOLOGY

In this section we present our proposed surround view system, the proposed System shall incorporate 4 wide angle (Fish-eye) cameras around vehicle such as to avoid the blind spots. The device consists of a display screen placed inside the vehicle's control panel and four fish-eye lenses positioned around the vehicle. The front bumper, rear bumper, and two rear-view mirrors all have fish-eye lenses.

The proposed work bears an outmost coast as stated.

1. 4 Units of 122-degree wide angled camera sensors – $4 * 1200 = \text{Rs. } 4800$.
2. A raspberry pie (Raspberry Pi 4 Model-B with 2 GB RAM) = $1 * 3500 = \text{Rs } 3500$.
3. The total cost of the setup would be around Rs. 8300

To guarantee sufficient overlap between each view, these lenses have a 122-degree wide-angle vision. Using an embedded system with a Freescale processor, a succession of image stitching operations can be used to create a 3D surround view on the vehicle's central control panel [2].

The full surrounding 360° view can be captured using fisheye photos from four cameras mounted on the front, sides, and back of a vehicle with orthogonal primary axes. These images can then be stitched together to produce an image that appears to have been taken from a virtual reality headset.

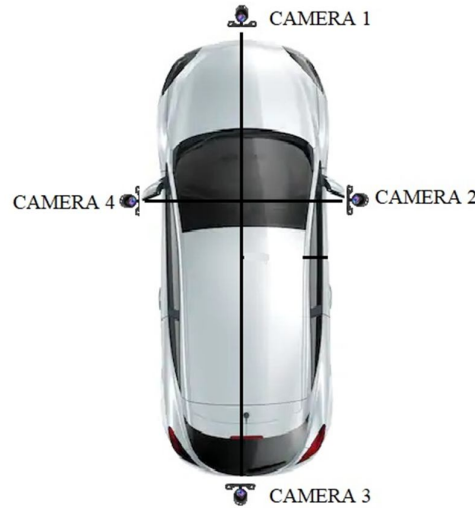


Fig.1: Overview of the Architecture incorporating the 4 cameras around the car are distributed at the front bumper, the rear bumper and under two rear-view mirrors.

The images captured by the fish-eye camera are severely distorted. If we want to use the projection information of severely distorted images, we must first correct these distorted images to look like the perspective projection images we are used to seeing. When the human eye observes a scene, objects in the distance appear smaller than objects in close proximity. This is referred to as perspective. The calibration parameters of the fish-eye camera must be obtained before the perspective projection images can be obtained. The calibration procedure has a direct impact on the panorama stitching results.

IV. RESULTS AND DISCUSSIONS

For our studies, we used four cameras with a horizontal field of view of about 122 degrees each and a resolution of 1280x720 pixels. 30 frames per second was chosen as the operational frequency. A typical time-stamping method that ensures a maximum temporal jitter of half a frame period was employed.

The cameras were manually adjusted and then extrinsically calibrated so as to form a seamless join of two adjacent feeds without much parallax. This process was done by placing objects on places which would be overlapped by two adjacent cameras. These objects of interest would be later used to join the feed and to get the desirable result.

The first phases of the experiments was to incorporate the image stitching features of OpenCV. The points of interest from all the 4 feed were used to overlap the images and stitch them together. Images from these 4 cameras were taken and fed to our algorithm which gave a desired output but when the same algorithm was used for video feed, it resulted in a very poor frame rates which was opposite to the objectives of our research work, hence this phase was discarded.

The second phase was lead with masking the feed in such a way that the points of interest from the feed were cropped exactly midway such that half of the object lied on one feed while its other half lied on the adjacent feed. These two masked feed when kept together gave an illusion that it's a seamless image, all the 4 feed were treated the same hence giving an appearance of the top view. Since there wasn't any complex mathematical functions involved in masking the feeds, the frame rates very high enough to be termed it as real time supporting the objective of our research work.

Even though there was a little bit parallax present in the last phase, we made an attempt to remove it completely by changing the perspective and warping the resultant image to match the key points on the feed. However this

phase was successful, this phase had to be discarded because of reduced frame rates because of the multiple mathematical functions involved.

We had to stick to the second phase results because of its higher frame rates.



Fig. 2: Individual views from the four cameras

Camera 1 being in front of the car
 Camera 2 being on the right side rear mirror
 Camera 3 being on the rear of the car and
 Camera 4 being of the left side rear mirror



Fig. 3: Resultant output of the phase 2

V. CONCLUSIONS

For each point for which a disparity estimate can be derived and which lies in the region of overlapping FOV between stereo fisheye cameras, we presented a new approach to calculate sufficient parameters for defining mappings in the top-view image. The foundation of our approach is the computation of perspective transforms from known ground-plane point locations. However, any off-the-ground locations can also be mapped to the top-view image using our recently introduced calibration settings. As a result, viewers will perceive things in virtual camera views from above to be more accurately represented and represented with more fidelity. We also provided a summary on how to map points to the virtual camera view using the new calibration parameters.

This research effort suggests a technique for producing surround images utilising a composite projection model as an image production camera model that combines perspective projection and equidistant projection. This technique uses equidistant projection to create images with a wide field of view that make it possible to comprehend distances and perspective projection to create images without distortion close to the vehicle. The experiment showed that our proposed method can produce images with horizontal lines in the surrounding area, with straight lines near the vehicle shown as straight lines on the image, and with little distortion when indicating the distance between the vehicle and objects as proportional to that on the image. The experiment used a variety of parking scenes captured using an experimental vehicle.

Thus, it has been demonstrated that using this technique will produce images with a broad field of view and clear direction and distance information between the vehicle and other objects. It is common knowledge that when parking, drivers look around the parking space any obstacles as well as at the other side of the road. Since drivers can simultaneously view these gaze spots from the generated images, our suggested strategy for parking assistance works well. In addition to helping the driver park, we think our suggested strategy will also be useful while the driver is backing up and making quick bends to the left and right. We want to see how well this technique works for driver assistance other than parking.

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