
ABSTRACT

Obstacle detection is a main key of autonomous vehicles. When communicating with huge robots in unstructured background, resilient obstacle detection is required. Few of the existing methods are mainly suited for the backgrounds in which the ground is comparatively flat and with roughly the same color throughout the terrain. A novel procedure proposed in the work presented here uses a monocular camera, for real-time performance. We compute the homographic between two successive frames by computing the fundamental matrix between the two frames. Estimation of fundamental matrix is followed by triangulation so as to estimate the distance of the object from the camera. We examine a difficulty intrinsic to any fundamental matrix-based outlook to the provided task, and show how the discussed way can resolve this difficulty by a huge level. An obstacle detection and distance estimation system based on visual particular attribute and stereo vision is hence discussed in the presented work.

KEYWORDS:

INTRODUCTION

The triangulation is defined as the procedure of deciding a point in 3D space given its projections onto two, or more, pictures. To tackle this issue it is important to know the parameters of the camera projection capacity from 3D to 2D for the cameras included, in the least complex case spoke to by the camera grids. Triangulation is once in a while likewise alluded to as reproduction. Triangulation is one of the most fundamental problems in computer vision. The problem can be stated as follows: Given a 3D point X projected to $x_i = P_i X$ in two or more cameras, recover the 3D position of X from its 2D projections. When X is consistent with the matched points x_i , this is a trivial linear problem. In practice, however, the measured and reprojected points do not exactly coincide, which causes the rays from the camera centers through the imaged points not to intersect in 3D. This may be due to uncertainties in relative camera poses or intrinsic (i.e. errors in P_i), or to the inherent difficulties in designing automated methods that perfectly match points to within subpixel accuracy across images. In the presence of noise, the triangulation problem becomes one of finding the 3D point that best describes the observed image points.

We assume that a point x in R^3 is visible in two pictures. The two camera frameworks P and P_1 relating to the two pictures are assumed known. Let Q and Q_1 be projections of the point x in the two pictures. From this information, the two beams in space comparing to the two picture focuses might effortlessly be processed. The triangulation issue is to discover the convergence of the two lines in space. At first sight this is a trifling issue, since meeting two lines in space does not exhibit huge challenges. Tragically, in the vicinity of commotion these beams cannot be ensured to cross, and we have to locate the best arrangement under some expected noise model. This is the triangulation problem.

Literature Survey- Iwan Ulrich(2008) Vision based obstacle detection is presented in this paper for mobile robots. There are different types of obstacles i.e. Appearance based and range based obstacles. In this system the robot is trained by driving it through its environment. Various sensors are used in detection of range based obstacles. Ultrasonic sensors are the cheapest among all but it suffer from specular reflections and poor angular resolution. It is difficult for sensors to detect flat and small objects. Color vision is used to detect small and flat objects. First colored

input image is filtered than it is transformed into HSI color space, and then their histograms are compared. Obstacle detection system is trained in away to perform it on indoor as well as outdoor environments with a single color camera.

Ashish R. Derhagawen and D. Ghose(2012) This paper exhibits a quick obstruction recognition algorithm for portable robots that uses a solitary shading camera as the main sensor to identify obscure snags in a situation. The calculation uses shading HSV histograms to order every individual pixel as having a place either to a snag, or the ground in light of its appearance. The framework is equipped for performing fast impediment discovery on both uniform and kaleidoscopic territories. The robot's only goal so far in our experiments has been to move around safely in unstructured environments by avoiding obstacles. An interesting line of future work could be to combine this system with navigation and path planning algorithms to allow it to move towards specific targets, or even for the exploration and mapping of remote locations.

James Bruce Tucker Balch and Manuela veloso(2010) In this paper , Vision frameworks utilizing district division by shading are urgent continuously portable robot applications, for example, robocup, or different areas where communication with hu-keeps an eye on or a dynamic world is needed. Customarily, systems utilizing continuous shading based division are either executed in equipment, or as particular programming frameworks that take advantage of area information to achieve the fundamental efficiency. However; we have found that with careful attention to algorithm efficiency, fast color image segmentation can be accomplished using commodity image capture and CPU hardware. Our paper describes a system capable of tracking several hundred regions of up to 32 colors at 30 Hertz on general purpose commodity hardware. We have presented a new system for real-time segmentation of color images. It can classify each pixel in a full resolution captured color image, find and merge regions of up to 32 colors, and report their centroid, bounding box and area at 30 Hz.

Richard I. Hartley and Peter Sturm(2011) In this paper , we consider the problem of finding the position of a point in space given its position in two images taken with cameras with known calibration and pose. This process requires the intersection of two known rays in space and is commonly known as triangulation. All the methods performed relatively for Euclidean re-construction, as measured in terms of 3D error. In the case of 2D error, only the methods polynomial, Poly-Abs iterative-LS, and iterative-Eigen perform acceptably, and the last two have the disadvantage of occasional non convergence.

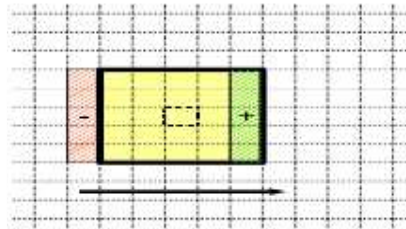
Ricardo neves and anibal c. Matos(2012) this paper presents an approach to stereovision applied to small water vehicles. By using a small low-cost computer and inexpensive off-the-shelf components, we were able to develop an autonomous driving system capable of following other vehicle and moving along paths delimited by colored buoys. A pair of webcams was used and, with an ultrasound sensor, we were also able to implement a basic frontal obstacle avoidance system. With the help of the stereoscopic system, we inferred the position of specific objects that serve as references to the asv guidance. The final system is capable of identifying and following targets in a distance of over 5 meters. The system we've developed is able to accomplish the function it's designed for under used 70. With this work, it's been proven that it there is the possibility of performing stereoscopic image processing using low cost computational units. Results of 2-3 fps were proven attainable. Although using more dense matching algorithms is still a difficult task to these small units, using simpler techniques evolving binary imaging and criteriously chosen 3d information is a good way of surpassing those limitations.

Lu'is Correia, Jose' Barata(2014) Using a novel voting filter higher level of roboutness can be attained. In proposed model the image is segmented into two parts i.e left image and right image than saliency computation and stereo processing are done which gives a 3 D point cloud using it detection of ground- plane is done. Stereo processing also gives attitude compensation.

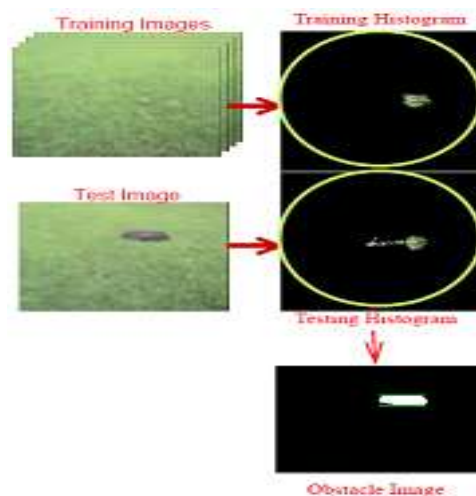
Piyush Chaudhary, Anand K. Chaudhari(2013) In this research image processing techniques are used for disease spot segmentation in plant leaf is implemented. Detection and classification of plant diseases is the first step as the disease spots are not different in intensity but they do differ in color. The different effects of color space are used in identifying the disease spot i.e CIELAB, HIS and YCbCr. For this we have to smoothen the image and for smoothening process of image this research uses median filter. After the smoothening of image is done the threshold can

be calculated by applying Otsu method on color component of disease spot. This algorithm is independent of plant type, color of disease spot, background noise. This research is carried out on different plant leaves i.e on Monocot family and Dicot family. In monocot family plants mostly veins are parallel and less visible and in Dicot family the veins form a netted pattern, they have larger veins which are thicker and straighter.

Dr. A. N. Cheeranand Sharda Godara(2007) In this research paper the process of disease spot detection compares the effect of YCbCr, HIS and CIELAB color space. In this research method is used which is independent of background knowledge and plant type as monocot and dicot family plant leaves are having both noise free and noisy background. Median filter is used to remove unnecessary spots of color transform images. Intensity of leaf vein is different and color of disease spot is also different but only disease spots are the region of interest, not the veins. Due to camera flash some noise may be introduced during collection of images of plants and this noise effects the detection. Image smoothing is used to remove all unnecessary spots, median filter is used. Median filter is nonlinear yet higher order statistics filter which replaces the center pixel value.



Parag H. Batavia and Sanjiv Singh(2005) In this research paper autonomous system obstacle detection is a key component when dealing in unstructured environments with large robots. Color segmentation works well if it is operated in a domain in which traversable areas are of relatively constant color for example: grass. For classifying image areas as obstacle or free space color is used in color segmentation. This segmentation method is based on training algorithm which shows examples of free space to the system. Therefore appropriate representations are learnt by the system. Poor man's stereo is a reference of stereo-base homography. The images are never stored as standard tuples of RGB rather conversion into a different color space is needed which is know as Hue-Saturation-Value (HSV) where as actual color is known as Hue or angle of point in cylinder, purity of color is known as saturation. These two components contains the information of the color. Value contains various things like intensity, brightness and height of the point. There could be illumination changes as we can get additional robustness to shadows if we ignore the value. First training images are used to make training histogram after that the test image is used for the formation of testing histogram and obstacle image form. After training process pixels are classified as obstacle or free space in the system. Anything in the image which is not a free space is classified as a obstacle.

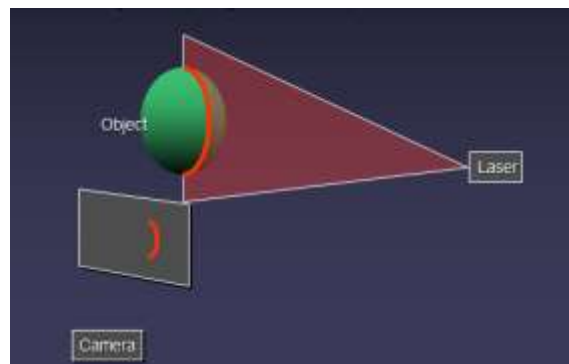


M. Veloso, E. Winner, S. Lenser, J. Bruce(2014) In this research real time segmentation of color images is represented as a new system. In this research each pixel can be classified as a full resolution captured color image. In this a region up-to 32 colors of an image can be found and merged. In this research centroids of the image can be reported, bounding box and area at 30Hz. Running length encodes each scan line according to the color of the image region. Regions can be sorted by size as well as colors. Efficient algorithms are used to speed up the approach and naive approach is discarded. In favour of a faster calculation we require up-to 192 comparisons per picture.

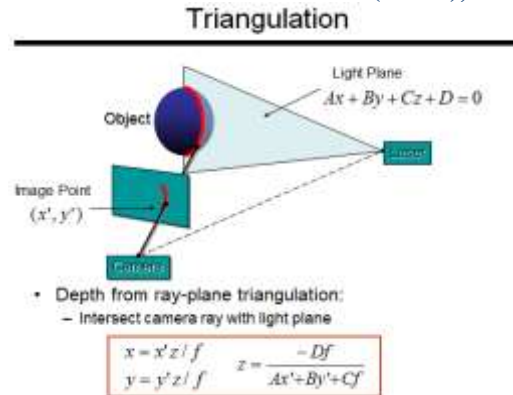
J. Wang, P. Huang, C. Chen, W. Gu and J. Chu(2011) In this research paper Detecting the unknown obstacles in an environment needs a fast obstacle detection array. These obstacles can be anything, even the smallest of the things can prove out to be an obstacle like a small ray of light, any luminous object, any dust particle. Each individual pixel should be classified whether it's of the image or the obstacle. For this classification HSV histograms are being used.

Springer Berlin Heidelberg (2009) In this research paper each camera has its intrinsic parameters and stereo rig has its own extrinsic parameters. In stereo calibration the acquisition of each image pair is seen by both cameras to find extrinsic parameters only if rig has a wider base line. Base line is the distance between the optical centers. For attaining the best calibration first of all each camera is calibrated and than camera pair is calibrated. A trigger input is included in the cameras used for industrial or scientific purpose. Cameras with a fixed baseline are purchased to solve the problem as low cost prototype has to be build as per original idea. Capturing an image in parallel stereo type demands left and right image acquisition on a moving scene for a given pair of images is made at the same time. Capturing of parallel image includes hardware synchronization, image acquisition.

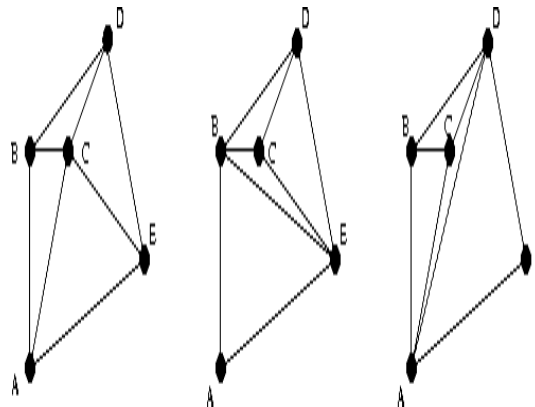
Triangulation techniques - In General, Triangulation is an approach to research that uses a combination of more than one research strategy in a single investigation. But Delaunay triangulations are broadly utilized as a part of investigative figuring in numerous different applications. While there are so many algorithms for computing triangulations, it is the great geometric properties of the Delaunay triangulation that make it so valuable. As shown in Figure



So The triangulation is defined as the procedure of deciding a point in 3D space given its projections onto two, or more, pictures. To tackle this issue it is important to know the parameters of the camera projection capacity from 3D to 2D for the cameras included, in the least complex case spoke to by the camera grids.



Delaunay triangulation Method: It maximizes the minimum angle of all the angles of the triangles in the triangulation. Some property of more than 3 points of Delaunay graph should be on same line or circle. These points form empty convex polygons, which can be triangulated. *Delaunay Triangulation* is a triangulation obtained by adding 0 or more edges to the Delaunay Graph. In this there are different ways on which we can triangulate any given set of points:



There are three possible triangulations of this set of points. Often we finalize the triangulation of that point which have Nice properties. One of the most common and useful such triangulations is the Delaunay triangulation.

CONCLUSION

This paper has tried to review a noteworthy number of papers to cover the recent development in the field of triangulation of image points from two image frames for 3-D reconstruction. The list of references to offer more detailed understanding of the methods described is enlisted. We express regret to researchers whose significant contributions may have been overlooked.

REFERENCES

- [1] R.C. Luo, T.Y. Lin, T.Y. Hsu, and P.K. Wang, Multisensor controlled obstacle avoidance and navigation of intelligent security robot, 31st IEEE Annual Conference of Industrial Electronics Society, Raleigh, NC, USA, pp. 1827-1832, 2005.
- [2] I. Ulrich and I. Nourbakhsh, Appearance-based obstacle detection with monocular color vision, Proceedings of the AAAI National Conference on Artificial Intelligence, Austin, TX, pp. 866-871, 2000.
- [3] Webb, E. J., Campbell, D. T., Schwartz, R. D., & Sechrest, L. Unobtrusive measures: Nonreactive measures in the social sciences. Chicago: Rand McNally.
- [4] R. I. Hartley. Estimation of relative camera positions for uncalibrated cameras. In Computer Vision - ECCV '92, LNCS-Series Vol. 588, Springer-Verlag, pages 579 –587, 1992.

- [5] R. I. Hartley. Lines and points in three views - a unified approach. In Proc. ARPA Image Understanding Workshop, pages 1009–1016, 1994.
- [6] Richard I. Hartley. Euclidean reconstruction from uncalibrated views. In Applications of Invariance in Computer Vision : Proc. of the Second Joint European – US Workshop, Ponta Delgada, Azores – LNCS-Series Vol. 825, Springer Verlag, pages 237–256, October 1993.
- [7] Jan J. Koenderink and Andrea J. van Doorn. Affine structure from motion. Journal of the Optical Society of America, A, 1992.
- [8] H.C. Longuet-Higgins. A computer algorithm for reconstructing a scene from two projections. Nature, 293:133–135, Sept 1981.2005
- [9] R. Mohr, F. Veillon, and L. Quan. Relative 3D reconstruction using multiple uncalibrated images. In Proc. IEEE Conf. on Computer Vision and Pattern Recognition, pages 543 – 548, 1993.
- [10] Jean Ponce, David H. Marimont, and Todd A. Cass. Analytical methods for uncalibrated stereo and motion reconstruction. In Computer Vision - ECCV '94, Volume I, LNCS-Series Vol. 800, Springer-Verlag, pages 463–470, 1994.
- [11] William H. Press, Brian P. Flannery, Saul A. Teukolsky, and William T. Vetterling. Numerical Recipes in C: The Art of Scientific Computing. Cambridge University Press, 1988. In Proc. KDD 2000 Workshop on Text Mining, Boston, MA.
- [12] Sahami, M., Dumais, S., Heckerman, D., & Horvitz, E. (1998, July). A Bayesian approach to filtering junk e-mail. In Learning for Text Categorization: Papers from the 1998 workshop (Vol. 62, pp. 98-105).
- [13] Song, Y., Kołcz, A., & Giles, C. L. (2009). Better Naive Bayes classification for high-precision spam detection. Software: Practice and Experience, 39(11), 1003-1024.