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Vein Pattern Detection System Using Cost-effective Modified IR Sensitive Webcam

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Abstract: ***Vein detection is one of the latest medical Imaging techniques researched today. Now a day's very few devices based on the IR technique have been implemented & researched there is strong demand to develop such devices. While the concept behind the IR imaging is simple, there are various challenges to be found throughout the design and implementation of a device concerning the illumination system, image acquisition system & the image processing algorithms at a very low price. The major problem faced by the doctors today is difficulty in accessing veins for intra-venous drug delivery & other medical situation. Blood clots, bruises, rashes, etc. occurs due to improper detection of veins. That's why a non-invasive subcutaneous vein detection system has been developed success-fully based on near IR imaging and interfaced to a laptop to make it portable. A customized webcam (CCD camera) is used for capturing the vein images and Computer Software module (MATLAB) is used for the processing. This system also has application in treatment of varicose veins, deep vein thrombosis, and vascular ailments & also in the area of finger vein pattern recognition & biometric applications.***

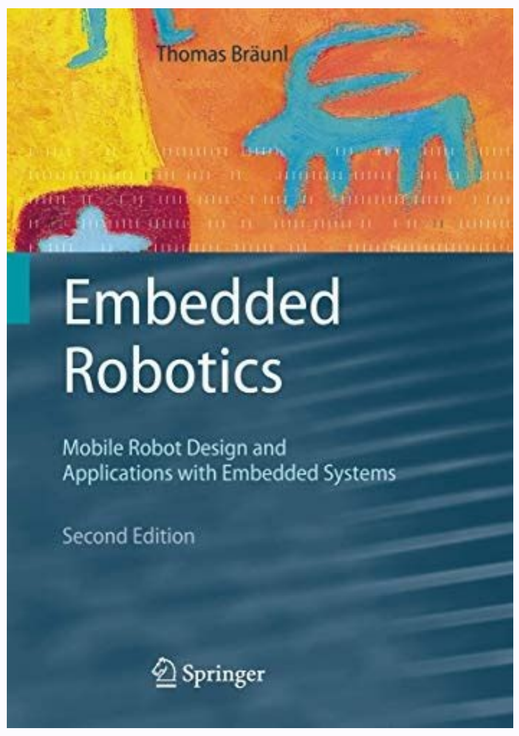
I. INTRODUCTION

The vein detection process consists of an easy to implement device that takes a snapshot of the subject's veins under a source of infrared radiation at a specific wavelength. The system is able to detect veins but not arteries due to the specific absorption of infrared radiation in blood vessels. Almost any part of the body could be analysed in order to extract an image of the vascular pattern. In many medical practices, X-ray and ultrasonic scanning are used to form vein images. These methods can produce high quality images for blood vessels; it is an invasive technique as it requires injection of agents into the blood vessels. This is not feasible for general purpose imaging applications in the real-world. Therefore, obtaining the vein pattern images in a fast and non-invasive manner is the key challenge in a vein pattern biometric system. However, no research has specifically addressed the issue of vein pattern acquisition, and there is a lack of analysis of the factors affecting the quality of the vein pattern images. This paper is thus motivated to investigate the utilization of infrared imaging technologies in this area of application. Generally there are two types of infrared imaging: Far-Infrared (FIR) & Near Infrared (NIR). NIR gives better results for vein detection because of its certain attributes as compared to FIR [1]. Far infrared imaging means red hot image, that recognition rate often greatly influenced by humidity and temperature, but near-infrared can use the advantage of special wavelengths infrared penetrates most human tissue easily, so it can acquire more clear and reliable image quality than far-infrared imaging[4].

II. NEED FOR VEIN DETECTION

When the doctors are treating trauma patients, every second counts. Bums and other physical injuries make it difficult to locate veins and administer lifesaving drugs. In such cases it becomes very necessary to have a device that detects the exact location of required vein. Also in case of blood transfusion, blood withdrawal, blood donation, etc. it is necessary to know the exact position of the veins. Even trained nurses and doctors many times find it difficult to exactly locate the blood veins, on the first attempt, especially for obese people. In various medical situations, the exact location of veins needs to be identified. The other situations where vein imaging is required are [2]:

- Intravenous injections: For giving medicines and drugs to the patients, intra- venous injections are given by doctors and nurses.
- Bruises and Bums: In case of vein diseases like Deep Vein Thrombosis and Varicose Veins, bruises appear on the skin, therefore for the treatment of these diseases, detection of veins is highly essential. Accidents involving first or second degree of bums cause the scarring of the skin. Here appearance of the skin becomes deterred causing the skin to appear whiter or in certain cases darker. The determinations of veins become tough in such cases as well.
- Blood transfusions: It is a process in which blood is given to the person intravenously. Blood donation, kidney dialysis also need perfect vein detection.
- Among children: Locating veins in young children and infants may be especially difficult and having to puncture them several times with a needle is very frightful and agonizing for the child.
- Geriatrics: Many elderly people often require numerous blood tests or medicinal injections and an efficient means of puncture would reduce excessive bruise and enhance the patients overall comfort level.



GLOBAL POSITIONING SYSTEM

1. **What is GDOP and VDOP?**

   GDOP (geometric dilution of precision) describes error caused by the relative position of the GPS satellites. Basically, the more signals a GPS receiver can "see" (spread apart versus close together), the more precise it can be. From the observer's point of view, if the satellites are spread apart in the sky, then the GPS receiver has a good GDOP. But if the satellites are physically close together, then you have poor GDOP. This lowers the quality of GPS positioning potentially by meters.

   VDOP (vertical dilution of precision) is a measurement of accuracy in standard deviation in vertical height. Mathematically VDOP is defined as

   $$\text{VDOP} = \frac{\sigma_U}{\sigma_R}$$

2. **What is the significance of DOP in positioning estimation?**

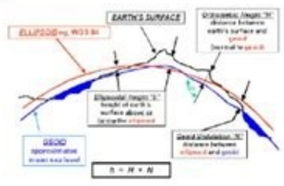
   The concept of dilution of precision (DOP) originated with users of the Loran-C navigation system. The idea of Geometric DOP is to state how errors in the measurement will affect the final state estimation. This can be defined as

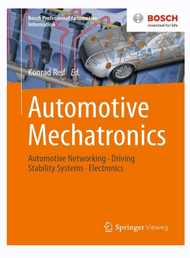
   $$GDOP = \frac{\Delta(\text{Output Location})}{\Delta(\text{Measured Data})}$$

   Conceptually you can imagine errors on a measurement resulting in the Measured Data term changing. Ideally small changes in the measured data will not result in large changes in output location, as such a result would indicate the solution is very sensitive to errors. The interpretation of this formula is shown in the figure to the right, showing two possible scenarios with acceptable and poor GDOP.

3. **Explain about the geometry of Ellipsoid**

   In geodesy, a reference ellipsoid is a mathematically defined surface that approximates the geoid, the truer figure of the Earth, or other planetary body. Because of their relative simplicity, reference ellipsoids are used as a preferred surface on which geodetic network computations are performed and point coordinates such as latitude, longitude, and elevation are defined.





Beijing: IEEE; 2016. 1-615.Al-Kaff A, Meng Q , Martin D, Escalera A, Armingol JM. Vehicle safety systems are generally classified into types [1]: (1) Active (DAS: Driver Assistance Systems) and (2) Passive. Some researchers consider it a sub-category of sensor-based approach but due to the diversity and a broad range of camera-based detection schemes, it has been presented as a separate category.Camera-based detection methods have been classified into three categories: (1) Knowledge based; (2) Stereo vision based, and (3) Motion based [4]. 512-5173.Habermann D, Garcia C. Noida, India: IEEE; 2019. 267-27212.Kumar RK, Jada C, Feroz MGI, Kumar VA, Yenala H. It should also be able to calculate the distance of the obstacle from the car. In [5], a more sophisticated road boundary and obstacle detection scheme has been used using a downward-looking LiDAR sensor. [1] discusses almost all general types of sensors used for collision avoidance that include: Acoustic, Radar, Laser/LiDAR, Optical sensors and the fusion of sensors. Learning framework for robust obstacle detection, recognition, and tracking. In: Tenth International Conference on Ubiquitous and Future Networks (ICUFN). In: 6th World Congress on Intelligent Control and Automation. Licensee IntechOpen. Similarly, [16] also discusses a bionic vision inspired approach using radar and visual information.AdvertisementAnother approach discussed in the literature [17] is a mechatronics system comprising a PID controller which predicts and controls the vehicle heading angle in order to follow the lane or to avoid the obstacles.AdvertisementSome studies present the use of laser scanner/rangefinder in order to implement obstacle detection and road following in an outdoor environment [18, 19]. 206-21011.Knoeppel C, Schanz A, Michaelis B. Vehicle detection techniques for collision avoidance systems: A review. Gothenburg: IEEE; 2016. In: IEEE International Conference on Signal and Image Processing (ICSIP). Multi sensorial data fusion for efficient detection and tracking of road obstacles for inter-distance and anti-collision safety management. 39-4417.Al-Zaher TSA, Bayoumy AM, Sharaf AM, El-din YHH. 607-611Submitted: April 1st, 2019Reviewed: September 25th, 2019Published: September 9th, 2020© 2020 The Author(s). Now a days, such vehicles have become a concrete reality and they have been created and extensively tested on roads, although they are not yet commercially available on a large scale.In autonomous vehicles, one of the most important features is the correct and accurate detection of obstacles as well as the track of the vehicle. 617-6215.Han J, Kim D, Lee M, Sunwoo M. Radar and Vision sensor fusion for object detection in autonomous vehicle surroundings. Track detection is also a very important factor as the vehicle must be able to keep itself within the limits of track and follow the lines on the road in order to remain rightly on the track and to follow the lane as well.This chapter deals with the study of various different approaches for obstacle detection and track detection that have been studied/implemented in the literature by different researchers. In this chapter, various studies and researches have been discussed that are present in the literature and focus on the obstacle detection and track detection features in autonomous cars. In: Latin American Robotics Symposium and Intelligent Robotics Meeting. 590-5938.Kim J, Han D S, Senouci B. Paris: IEEE; 2012. Dalian: IEEE; 2006. 92-9716.Wang X, Xu L, Sun H, Xin J, Zheng N. In [13], one such approach is discussed which uses multiple sources of local patterns and depth information to yield robust on-road vehicle and pedestrian detection, recognition, and tracking. Obstacle detection and classification using deep learning for tracking in high-speed autonomous driving. Cochin. This chapter is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License, which permits use, distribution and reproduction for non-commercial purposes, provided the original is properly cited. This technique outperforms the commonly used camera-

based vision techniques in situations such as different weather conditions (e.g. sun, rain, and fog), and different appearances of road (e.g. clay, mud, gravel, sand, and asphalt) [18].AdvertisementDetecting an obstacle and keeping a track of the lane and road is one of the primary objectives in an autonomous vehicle. 2002;4:74-7710.Surinta O, Khruahong S. Prague: IEEE; 2018. pp. Lane tracking and obstacle avoidance for autonomous ground vehicles. Monocular vision-based obstacle detection/avoidance for unmanned aerial vehicles. In: IEEE Intelligent Vehicles Symposium (IV). [14] discusses obstacle detection and classification using deep learning for tracking in high-speed autonomous driving.AdvertisementA relatively uncommon and novel approach is to use a monocular camera to mimic the human behavior of obstacle detection and avoidance applied on UAVs [15]. IEEE Transactions on Vehicular Technology. Autonomous vehicles are able to perceive their surroundings (obstacles and track) and commute to destination with the help of a combination of sensors, cameras and radars. Real time obstacle detection method based on LIDAR and wireless sensor. Obstacle detection and tracking using laser 2D. In: 9th France-Japan & 7th Europe-Asia Congress on Mechatronics (MECATRONICS)/13th Int'l Workshop on Research and Education in Mechatronics (REM). Obstacle detection and road following using laser scanner. Another study [6] presents a LiDAR and wireless sensor-based real time obstacle detection method.Many researches have discussed use of radar sensors for obstacle and track detection [1, 7, 8]. DOI: 10.1109/TITS.2016.261481814.Prabharkar G, Kailath B, Natarajan S, Kumar R. A wide variety of techniques discussed in the literature have been categorized and summarized according to the methodology and application of a particular technique. [8] uses radar and vision sensors for accurate detection of obstacles.AdvertisementThe second most popular approach is the camera-based approach that is used for detecting the track and obstacles in autonomous vehicles. Object tracking and state estimation in outdoor scenes based on 3D laser scanner. They are summarized in Table 1.Cooperative SensorsTraffic Alert Collision Avoidance System (TCAS)Automatic dependent surveillance and broadcasting (ADS-B)Non Cooperative SensorsRADARSonarLiDARElectro-OpticalInfrared SensorsAcoustic SensorsSensor FusionTo fuse the information obtained from different sensorsThe most commonly used sensors in autonomous vehicles are LiDAR and RADAR that are discussed below:In [3], a 2D laser sensor is used for obstacle detection and tracking. IEEE Transactions on Intelligent Transportation Systems. Qindao: IEEE; 2014. It also discusses their advantages and disadvantages.Sensors can be broadly classified into two categories [2]: (1) Co-operative sensors and (2) Non co-operative sensors. In: International Conference on Digital Arts, Media and Technology. A number of different sensors and related technologies have been discussed in the literature. Object Recognition Supported by User Interaction for Service Robots. IEEE; 2019. 76-789.Lefaix G, Marchand T, Bouthemy P. Object detection and identification using vision and radar data fusion system for ground-based navigation. [10] discusses tracking of people and objects with an autonomous UAV using two schemes: (1) Face Detection and (2) Color Detection. 5951-59557.Jha H, Lodhi V, Chakravarty D. 2012;61:971-985. This chapter helps understanding and categorizing the different techniques used for obstacle detection and tracking as well as the researches that refer to these techniques.1.Mukhtar A, Xia L, Tang TB. Therefore, obstacle detection and track detection falls into the category of active vehicle safety systems.AdvertisementThe most common and widely used approach for both obstacle detection and track detection is the sensor-based approach. Mysuru: IEEE; 2017. Nagoya: IEEE; 2017. It records the motion parameters of the host vehicle to determine the driven path. In: 6th International Conference on Signal Processing and Integrated Networks (SPIN). In: 3rd International Conference on Control, Automation and Robotics (ICCAR). IEEE; 2017. In: International Conference on Signal Processing and Communication Engineering Systems. It is also known as a driverless car, self-driving car, unmanned vehicle or a robot car. Sense and avoid technology in unmanned aerial vehicles: A review. 120-1254.Aijazi AK, Checchin P, Trassoudaine L. Advanced control systems can interpret the information provided by sensors to detect obstacles and choose the most suitable navigation path for the vehicle. DOI: 10.1109/TITS.2015.24091092.Chand BN, Mahalakshmi P, Naidu VPS. Motion-based obstacle detection and tracking for car driving assistance. This chapter illustrates the history and recent advancements in the field of Autonomous Vehicles with regard to two important concerns that play the most vital role in successful implementation and working of an Autonomous Car: (1) Obstacle Detection and (2) Track Detection. Jinan: IEEE; 2017. Active systems include collision avoidance system, automatic braking, adaptive cruise control and lane departure warning system, whereas, passive systems generally comprise features such as seat belts, air bags, crumple zones and laminated windshields. Bionic vision inspired on-road obstacle detection and tracking using radar and visual information. 264-27118.Xu Z, Zhuang Y, Chen H. ROBOG: An autonomously navigating vehicle based on road detection for unstructured road. Chinese Automation Congress (CAC). In: IEEE Region 10 Symposium (TENSYMP). Enhanced road boundary and obstacle detection using a downward-looking LiDAR sensor. These categories have been summarized in Table 2.Knowledge-based approachA priori knowledge of obstacles: symmetry, color, shadow, corners, vertical and horizontal edgesStereo vision-based approachUsing a disparity mapUsing inverse perspective mapping (IPM)Motion-based approachSummary of camera-based detection methods.In [9], detection and tracking of obstacles is done from a camera mounted on a vehicle with a view to driver assistance. The car should be able to detect the obstacles for smooth and efficient working in order to avoid accident and collision. 2015;16:2318-2338. Sao Bernardo do Campo: IEEE; 2010. It can be considered a sub-category of camera-based approach, but due to its novelty from the conventional camera-based approaches, it has been presented as a separate category. Similarly, Track Detection is also important as the autonomous car should stay within a predefined track and has to keep itself within the yellow lines on both sides of the road. Dearborn, MI, USA: IEEE; 2000. [7] uses radar sensors and uses vision and radar data fusion system for ground-based navigation. In: Proceedings of the IEEE Intelligent Vehicles Symposium. The vehicle or car should be able to detect the presence of an obstacle precisely and well in time so that it can stop itself at a safe distance in order to avoid the collision. 29-3313.Nguyen VD, Nguyen HV, Tran DT, Lee SJ, Jeon JW. DOI: 10.1109/TVT.2012.21827856.Zhang J, Han J, Wang S, Liao Y, Li P. Enormous research has been carried out to bring the idea of autonomous car to life. Guntur: IEEE; 2015. [12] introduces ROBOG, an image-based detection system, that is meant for road detection for unstructured roads.AdvertisementThere are also many deep learning approaches available for obstacle detection and tracking. In: International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT). Robust vehicle detection at large distance using low resolution cameras. 2017;18:1633-1646. This chapter elaborates the technologies and advancements that have been presented in the literature till date that deal with Obstacle Detection and Track Detection in Autonomous Cars/Vehicles.autonomous carsobstacle detectionself-driving carstrack detectionunmanned vehicleAn autonomous car is a vehicle that can guide itself without human command and control. In [4], an automatic obstacle detection and tracking system has been introduced that fuses 3D Light Detection and Ranging (LiDAR) and 2D image data for efficient inter-distance and anti-collision management. 8630-863419.Wang X, Li H, Liu B. In [11], a robust vehicle detection system is described that detects vehicles in the rear view of the host car. In: 17th International IEEE Conference on Intelligent Transportation Systems (ITSC). Tracking people and objects with an autonomous unmanned aerial vehicle using face and color detection.

EMA3D CABLE CAPABILITIES. Simulate System-Level Cable Electromagnetic Compatibility (EMC) and Real-World EMI Events. When you're designing the wiring harness for the controls system of a helicopter or the power distribution system of a next generation electric vehicle (EV), unwanted electromagnetic system effects can drastically uphold long-term production and cost … It visualizes and verifies detected objects, supplements measurement data with meta-information and much more. Thanks to an open interface in CANape, integration of additional sensors and components is possible in almost any way. The sensors are physically connected via the VX1000 product family or via Ethernet with the VN products. Understand and Simulate Fatigue Early in the Design Process. Ansys nCode DesignLife works with Ansys Mechanical and Ansys LS-DYNA to reliably evaluate fatigue life. You can quickly evaluate the effects of different materials and alternative geometries for new designs, and then optimize them for the product's expected usage before a costly prototype. How to Avoid (and Fix) a Bum Ankle. Ankle instability is often the result of nerve and ligament damage. These exercises can help get you back on, and stay on, your feet. CES (/ , s i. i. ˈ ɛ s /; formerly an initialism for Consumer Electronics Show) is an annual trade show organized by the Consumer Technology Association (CTA).Held in January at the Las Vegas Convention Center in Winchester, Nevada, United States, the event typically hosts presentations of new products and technologies in the consumer electronics industry.