INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

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Automatic Visual Navigation Using Stereo Vision and Applications

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Abstract: *In the last decades advances in computing hardware coupled device with the availability of different types of advanced robotic sensors and automatic technology have brought the dream of autonomous robots closer to reality now. Not adventure, good map making and localization are critical to the autonomous and common operations and navigation of these robots and related automatic machine. In this paper, the main focused to concentrate on showing how it is possible to build a visual navigation consistent, globally correct map for outdoor and indoor un-structured, structure environments both in real time using stereo vision as the primary stage sensors.*
Keywords: *Automatic Computing, Visual Navigation, Sensor Navigation, Stereo Navigation*

1. Introduction

The main goal is for a small outdoor robot to come into a new area and new technology, learn about and map its environments, and move to a given goal at modest speeds. This problem is especially difficult in outdoor and indoor both, off-road environments, where tall grass, shadows, deadfall, and other obstacles predominate. Although work in outdoor and indoor navigation has preferentially used laser range renders [1, 3, 5]. The main focused to use stereo vision as the main sensor and related technology 3D visual navigation. Stereo vision is a good choice for several as well as different points of view: it is low power, low cost, low maintenance and can register dense range information from close objects. More importantly, vision sensors allow us to use more distant objects as landmarks for three dimension navigation, and to learn and use color and texture models of the environment, in looking further ahead than is possible with range sensors alone. Our robot uses a combination of the following vision-based techniques to make globally consistent maps in real time technology. The real time technology represents the real view of different way of specific machine like robotic, automatic machine, network sensors.

2. Navigation Techniques

Techniques for tracking moving elements (corners, lines, object outlines or specific regions) in a video sequence have become robust enough so as to be useful for navigation. Many times, the systems divide a tracking task into two sub-problems [4] first, motion detection, which, given a feature to be tracked, identifies a region in the next frame where it is likely to find such a feature, and second, feature matching, by which the feature tracked is identified within the identified region.

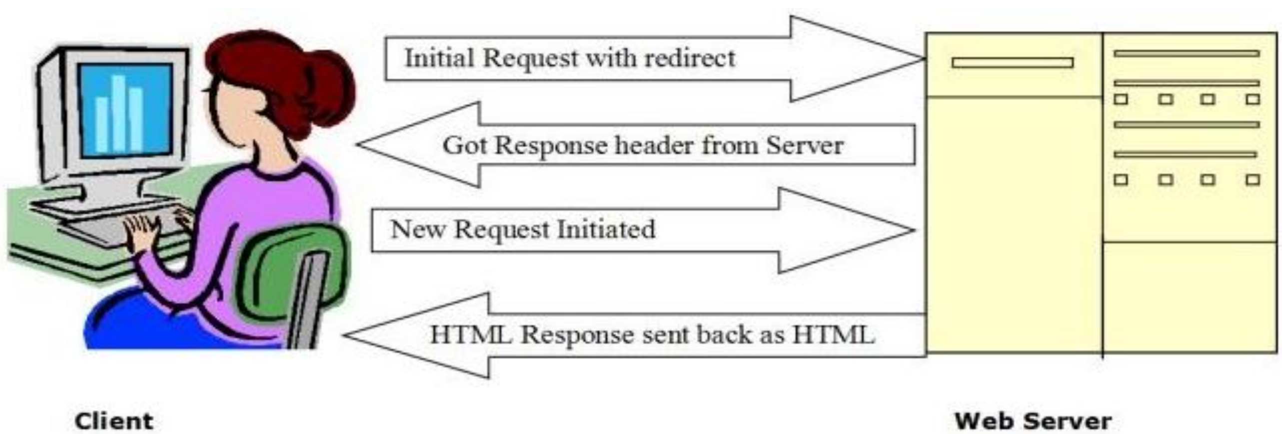

Figure1: Visual navigation technique

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In general, feature tracking-based navigation approaches do not comprise an obstacle avoidance module, but this task has to be implemented by other means. Although video tracking and mobile robot navigation belong to separate research communities, some authors claim to bridge them to motivate the development of new navigation strategies. Some authors center their research in detecting and tracking the ground space across consecutive image s, and steering the robot towards free space. Pears and Liang use homographies to track ground plane corners in indoor environments, with a new navigation algorithm called H-based Tracker [10]. The same authors extend their work in [7] using also homographies to calculate height of tracked features or obstacles above the ground plane during the navigation process. The accuracy of the navigation strategy must be a strategic point in aerial motion where the speed is high, the processing time must be reduced and the tracking process needs to be more accurate. In [1] propose a new image tracking strategy that computes and uses a homography matrix to compensate the UAV motion and detect objects. This system improves their previous work [3] maintaining the tracking successes despite the number of attempts are reduced. [1], and [4] compute and use the homography matrix to detect and track the ground plane over previously tracked image corners or edges using the Harris corner detector [6]. In a more recent work, other authors prefer to combine the concept of feature tracking with stereo 3-D environment reconstruction. In [7], stereo vision is used in a novel navigation strategy applicable to unstructured indoor/outdoor environments. This system is based on a new, faster and more accurate corner detector. Detected features are 3D positioned and tracked using normalized mean-squared differences and correlation measurements. Support vision information with GPS data in outdoor environments is another possibility of in-creasing reliability in position estimation. [8] Combine a feature tracking algorithm with GPS positioning to perform a navigation strategy for the autonomous helicopter [9].

3. Parity Vector

The GPS system has become the system of choice for navigation due to its performance and re-liability. Even though it is a fairly reliable system, its use in safety critical systems required that the reliability be guaranteed. This resulted in a considerable amount of research and development of integrity monitoring algorithms, the foremost of which is Receiver Autonomous Integrity Monitoring (RAIM) [2]. RAIM is the most useful method developed to date, in that; it is passive and localized to the GPS receiver without a large and complicated infrastructure of additional sensors. RAIM algorithms are not standardized among receivers, but they primarily rely on least squares residuals from a particular instant of data or similar method using a parity vector [1]. Both methods have been found to be equivalent [5] and have performance limitations in the ability to detect and exclude bad measurements. They also make the assumption that there is a single measurement error, which is a valid assumption for GPS [6, 9]. The parity vector method for integrity monitoring was first presented by [3] for monitoring inertial navigation systems. It was then reintroduced as a method of integrity monitoring for GPS by [1].

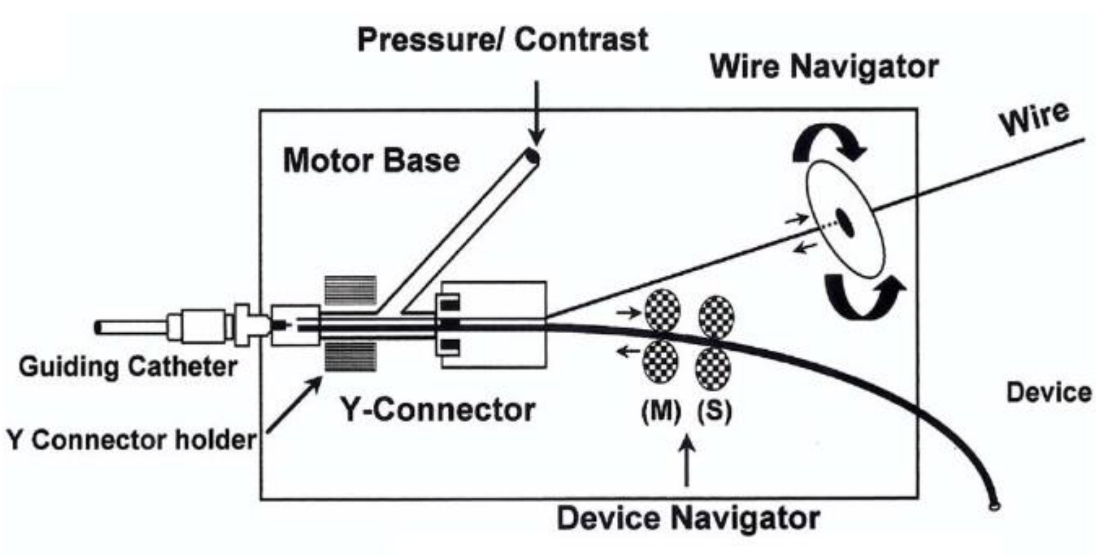

Figure 4.1: Automatic GPS Navigation systems

ISSN 2320-6802

INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

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The following is a derivation that mirrors the one presented in mathematical detail by [3] .The parity vector method is dependent upon the presence of redundant measurements. In other words, the number of measurements m, must exceed the number of states n being estimated, such that m n 1. A linearized measurement model is given by:

$$z = Hx + w + b$$

Where z is the (m1) measurement vector that results from the product of the (m, n) measurement matrix H and the (n1) state vector x plus the (m1) vector of measurement noise w

4. Conclusion

Navigation vision has become one of the cheapest, challenging and promising via for robots to perceive the environment. Accordingly, the numbers of prominent navigation approaches based on vision sensors have increased exponentially. Visual navigation techniques have been applied on almost all environments and in all kind of robots. The most outstanding pieces of work related with visual navigation from the early nineties until nowadays have been included in this paper to be used as a reference for novel and experienced researchers that want to first explore the possibilities of this trend. Map-based navigation techniques have been contrasted with those systems that do not need a map for navigation in an attempt to precede gradually from the most deliberative navigation techniques to the most pure reactive solutions. Ground robots do not span the whole amount of applications revised in this chapter but cover almost all the strategies considered. Apparently, some strategies seem to be exclusive of ground robots because they are rarely found in aerial or underwater vehicles.

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