



Unmanned Ground Vehicle

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Abstract: - Unmanned ground vehicle is a smart autonomous vehicle that mainly capable to do tasks without the need of human operator. the automated vehicle works during off road navigation and mainly used in military operation i.e. detecting bombs, border patrol etc. This type of vehicle mainly use sensors to observe the environment and automatically take decisions about its behaviour or pass this information to human operator who control the vehicle through teleoperation. There are many technique used to overcome the problems of UGV and can detect obstacles during off road navigation. So in this paper, we proposed an image segmentation i.e. region based technique to identify obstacles i.e. cars, trees, human that come in the path of UGV and used some parameters to calculates the move of it during on road navigation.

Keywords— Unmanned ground vehicle, image segmentation, autonomous, region segmentation, remote, and sensor.

I. INTRODUCTION

Over the past few years, UGV has been used in different applications like military and civilian operations i.e. border patrol, surveillance, law enforcement, hostage situation, police for some specific mission i.e. detecting and diffusing bombs etc. The ability to detect obstacle autonomously is very crucial to the safety of mobile robots and robot navigation [16, 20]. UGV is a smart autonomous vehicle that is capable to do tasks in structured or unstructured environment without the help of human operator. It use different type of sensors to sense the structured or unstructured environment then based on sense it take the action and then pass the sensed information to the different computer operator at the different location through the communication links. This type of automated vehicle can carry any thing that human can't do easily [1,2,3,4].

A. Classes of UGV

UGV are mainly classified into two classes:

- Remote operated
- Autonomous operated.

1) Remote Operated

It is a vehicle that operates with the help of human operator via a communication link. All the activities which are performed by it are observed by the operator either through direct visual observation or remote use of sensor such as a digital video camera. For examples a toy remote control car, explosives and bomb disabling vehicles. [20]

2) Autonomous Operated

It is an autonomous vehicle that mainly operates without the help of a human operator. This type of vehicle use sensors to sense the environment which is then used by control algorithm to take a next action to achieve a goal. It has the ability to learn autonomously. For example a Vislab's autonomous car etc. [20]

B. HOW DOES UGV WORKS

Suppose an autonomous vehicle in which sensor fitted over the vehicle which sense the structured or unstructured environment and then based upon senses it take the decision to achieve a goal and then pass the output to the computer operator which is at the different location through communication link whose output is checked by human

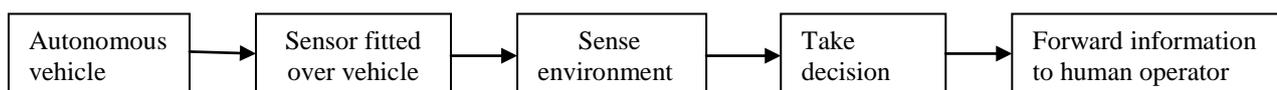


Fig 1: How does unmanned ground vehicle works

Image segmentation is one of the most important task in digital image processing and used in many applications i.e., medical, image compression, object detection, recognition tasks, satellite images etc [1, 2, 3, 4, 20].

Image segmentation is the process of dividing an image into different segments i.e. set of pixels. Then extract the meaningful information from segment part which is helpful to take the decision. [14]. Segmentation can be done based on two approaches: First approach is based on detecting discontinuities that means to partition an image based on abrupt changes in intensity e.g. Edge detection. Second approach is based on detecting similarities that means to partition an image into regions that are similar according to some predefined criteria e.g. Region growing, Region splitting and Region merging. [14] Each approach has its own advantages and disadvantages. First is Thresholding technique is a very simple method for image segmentation which is basically used to separate foreground from a background of an image. It is based on region i.e. properties (color, texture) of an image. Thresholding operation is mainly convert a multilevel image into a binary image i.e., it decide a threshold T , to divide image into several regions and separate objects from background. Any pixel (x, y) is considered as a part of object which is a foreground if its intensity is greater than or equal to threshold value i.e., $f(x, y) \geq T$, else pixel belong to background [14]. edge detection is also a method used for image segmentation to detect edges between regions that have rapid change in intensity are extracted [1, 5, 19] and linked to form closed object boundaries. Edge based segmentation algorithms are usually less complex and in these algorithms edges are important features in an image to separate regions. Region based segmentation cover more pixels than edge based and thus more information is available in order to characterize region. Region growing techniques are better in noisy images where edges are difficult to detect [18]. Region growing methods can correctly make the regions that have same properties [14]

In this paper, region based image segmentation technique is proposed to identify the obstacles that come in front of UGV and also used some parameters to calculate the moves of UGV.

Section II describes the previous works that have done in unmanned ground vehicle. Section III then describes need and significance of UGV and Section IV describe proposed methodology, Section V describes the conclusion.

II. RELATED WORK

This section gives an overview of the related research that has been done regarding autonomous navigation for unmanned aerial vehicles. Some of these are as following:-

Matthies, Larry, et.al [5] in this paper, authors developed a real time stereo vision system that uses Data cube MV-200 and a 68040 CPU board to sense terrain geometry and composition under night, day and low visibility conditions. But stereo still considered too computationally expensive for unmanned ground vehicle detect obstacles during off-road autonomous navigation and also it provide sufficient quality of the range data and work in a limited range.

Somboon H.et.al[6] in this paper, authors proposed an activity representation and probabilistic recognition methods which are mainly used to detected and segmented events from video data automatically by a probabilistic analysis of the shape, motion and trajectory features of moving objects. But main problem of these methods are tracking a crowd of people, necessary for many surveillance applications, is also still very difficult due to self-occlusion and the occlusion of the body parts with others.

Maria T.et.al [10] in this paper, the authors presented a dynamic visual attention method used to segment the scene into moving objects—vehicles and pedestrians—and background, without using a reference image or modeling the background. Its disadvantages is that parameter tuning does not depend on each different situation stored in a video sequence taken from the camera, but only on the predefined attention focuses and also this method model used to monitor static environments

Massimo Bertozzi.et.al [7] presented a paper in which they have proposed a terramax vehicle which could move autonomously only up to 68kmph and it can't work during the night and its performance is not impressive because of vehicle size and height.

Pangyu Jeong.et.al [11] in which authors proposed a Local Difference Probability (LDP)-Based Environment Adaptive Algorithm for road area detection and recognition and the proposed method solves the problems that occur when using generic classification and/or predefined model-based road-detection methods. The degree of flexibility is increased because it can be implemented in structured or unstructured environments that have different road features, different image quality, and different camera pitch angles. But the main problem of this algorithm is that it is only used for road-area detection and recognition.

Powsiri Klinkhachorn.et.al[12] which authors proposed a Non-Destructive Testing of Fiber-Reinforced Polymer (FRP) technique which use both IRT and GPR make the UGV to gather valuable data that can be used to identify both air and water-filled defects it is mainly used to minimize the human but still but it is not a fully functional analysis system. Whereas some data analysis is done on the IRT data, no GPR automation done except collecting the data.

Durst.et.al [8] in which authors proposed a new environment called Autonomous Navigation Virtual Environment Laboratory (ANVEL). it uses video game technology and physics-based modeling techniques to provide an M&S toolkit that is intuitive, interactive, and physically meaningful for unmanned ground vehicle but it is mainly operate during off road navigation and UGV can detect and avoid obstacles in static environment.

James M. Walker.et.al [13] presented a paper in which authors proposed a Constraint-Based technique for semi-autonomous vehicles in which homotopies and their associated constraints are identified, planned, and enforced to ensure that the controlled system avoids hazards and loss of stability without unduly restricting the control freedom of a human operator. But this technique became impossible for the controller to turn the wheels fast enough to avoid collisions and controller system can avoid hazards during off road navigation

Saurabh Trikande et al. [9] proposed visualization technique for UGV using 3D point cloud which give depth information, uses 3D scanner which scans environment in front in one plane and perceive the output in 3D point clouds. The Cluster extraction enables to extract the cluster in the point cloud which is mainly help to identifying the objects of interest i.e. Bomb .but it is mainly used in unmanned ground vehicle for home land security.

III. NEED AND SIGNIFICANCE

As per discussed in literature, there are different types of techniques are used in the field of unmanned ground vehicle to detect and avoidance of obstacles but there are many problem in existing techniques:

- Local Difference Probability (LDP)-Based Environment Adaptive Algorithm is only used to for road –area detection and recognition [11].
- Visualization Technique for UGV Using Point Clouds is used to identifying the objects of interest i.e. Bomb etc but only used for home land security [9].
- Constraint-Based technique became impossible for the controller to turn the wheels fast enough to avoid collisions and controller system can avoid hazards during off road navigation [13].

So these types of automated vehicles are required even in driving road vehicles where human errors cause Major fatal loss of life and property. For this purpose the functionality of unmanned ground vehicle can be enhanced by using region based image segmentation which will help to identify the obstacles that come in the path of UGV.

IV. PROPOSED METHODOLOGY

To overcome the problems of existing technique, in this paper proposed an image segmentation technique i.e. region based used to identify different types of obstacles with the following steps:

1. Record a video which consists of road, cars, humans & trees using camera.
2. Extract the appropriate frames from the recorded video which meet the requirement of pre-processing. For example blurred and distorted images will not make it good.
3. Convert extracted frames into gray level.
4. Applying region based segmentation algorithm to detect different objects in the image.
5. Bounding the different segmented objects (i.e. cars, human) in proper rectangular boxes in the frame.
6. Implementing an efficient Decision making table for deciding the moves of the vehicle.
7. Compare proposed segmentation technique with existing techniques.

V. CONCLUSION

In this paper, different types of algorithms have been discussed in the field of unmanned ground vehicle to detect and identify obstacles. Based on the review of literature, we have concluded that existing algorithms have various problems. Image segmentation is widely used in many fields such as object recognition, image compression, medical, satellite. Thus, A method of image segmentation i.e. region based is proposed that will help to detect and identification of objects (i.e. cars, human, trees etc.) that come in the path of unmanned ground vehicle during on road navigation and also used some parameters will be help to calculates the moves of vehicles.

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