# Depth Estimation in Image Processing using MATLAB

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*Abstract*— There has been a new revolution in computer interface design thathas changed the way we think about computers. There are technical computing environments available such as MATLAB that has now reshaped the role and applications of computer laboratory projects so as to involve individuals in more intense problem-solving experience. Due to such availability an opportunity has been provided to easily conduct numerical experiments and to tackle realistic and more complicated problems. In this paper we have tried to create an infrastructure that allows a human to collaborate in a natural manner with a robotic system. For technical computing, MATLAB [1] has been a high-performance language. Computation, visualization, and programming environment can all be integrated using MATLAB. Furthermore, for modern programming language environment, we can use MATLAB as it has sophisticated data structures, containsbuilt-in editing and debugging tools, and supports object-oriented programming. Due to these factors MATLAB has been an excellent tool for teaching and research. The paper presents a novel approach for distance estimation using a single camera as input using MATLAB. In particular we discuss a method for depth estimation using camera parameters and also image geometry. The system has been implemented for specific camera parameters.

***Key words:*** MATLAB, Depth, Object-Oriented Programming, GUI (graphical user interface)

## I. Introduction

Recent advances in driver assistance systems such as Lane Departure warning (LDW), Dynamic High Beam (DHB), Forward Collision Warning (FCW) etc., use monocular camera for their applications. Many of the existing systems (available in high end models such as Mercedes E Class, BMW 7 series etc.,) have bundled some of the above applications together in a single embedded platform providing easy of hardware usage, with overall cost reduction. Considering the above trend, monocular camera systems are in high demand and it's become a necessity to process images obtained from single camera. Depth estimation is a crucial task in applications such as collision avoidance systems, dynamic high beam assist systems etc., Depth using single camera is challenging since the camera image is subject to perspective distortions. A much better estimate can be achieved using the road geometry and the point of contact of the vehicle and the road [7].Considering the trend these days, monocular camera systems are in high demand and it's become a necessity to process images obtained from single camera. Based on the camera properties and geometry applied to the input images, relation between 2D and actual 3D view of the image is estimated. The depth estimation technique uses two different approaches to compute the in-path distances and oblique distances[1]. Detection of moving objects in video streams is the first relevant step of information. There is a variety of object tracking, detection and finally depth estimation algorithms available along with its publications[2]. This paper proposes a systematic review of one of these algorithms. The demand for assistive technologies for persons with various types of disabilities has always existed. However, with the advance of technology has made possible to develop technological devices capable of supplying albeit rudimentary, these demands. Considering this scenario, one of the most difficult disabilities to be compensated through technology is the loss of vision, especially for the high complexity physics that involves the seen process. Despite its difficulty, several attempts have been made to develop devices capable of giving out to the visually impaired people some information about obstacles around them. Mostly of new devices for this purpose is based on ultrasound technology. Despite these ultrasound based devices work in a satisfactory way, this kind of device still presents some intrinsic problems as ultrasound reflection and interferences from the environment. Within this conception, this work seeks to find new possibilities for electronic canes evaluating the proposed technology in terms of effectiveness and reliability. Image processing using MATLAB is already used in several industrial applications in computing platforms. With new portable cameras widely used today it is possible to develop assistive technologies based on image processing in MATLAB with high reliability of metering. The main purpose of this study is to evaluate the performance of processing image in MATLAB working together with an RGB camera in order to detect and measure distances so this technique can contribute to implementing equipments such as an electronic cane[3]. There are occasions where a polished user interface, specifically a graphical user interface (GUI) is desired:

- You wish to have a nontechnical, yet computer literate, person use your programs to perform some ongoing data analysis task, etc.
- You wish to share your tool (program(s)) with other members of your work group, but want the interface to be friendly
- You are writing a utility function for your own use and would like it to be easy to use
- You wish to build an interactive demonstration to best show off a concept or idea to others, e.g., others students etc.
- You or your company is a third-party developer of tools for the MATLAB user community.
- Since MATLAB is a cross-platform software package (primary platforms include Win95/NT, Unix, and Macintosh) the
- GUI components are derived from those in common to all the supported platforms
- In MATLAB 4 GUI design required hand coding of GUI components; some add-on tools such as GUIMaker1 were available later.

– With MATLAB 5 a multipart GUI building tool named Guide, which stands for Graphical User Interface Development Environment, was introduced (Guide is also included in the student edition)

## II. Methodology

We consider the task of 3-d depth estimation from a single still image. We take a supervised learning approach to this problem, in which we begin by collecting a training set of monocular images (of unstructured indoor and outdoor environments which include forests, sidewalks, trees, buildings, etc.) and their corresponding ground-truth depthmaps. Then, we apply supervised earning to predict the value of the depthmap as a function of the image.

The methodology part includes a step by step procedure including designing the GUI (Graphical User Interface) part, creating the video object, detecting the object and finally calibrating the distance of the object from the webcam in real time.

In GUI designing the function of the different toolbox used is defined by the user and coding part is generated by the software itself. Once the designing part is done by the user then the main programming of the depth estimation is compiled in the MATLAB. The programming part is divided into four main sections. First is to initialize the camera, second is to initialize the timer, third part is to detect the object and creating its axis and the fourth step is to calibrate the distance using the formula. Although the distance between the two objects can also be determined by finding the centroid with some changes in the programming. But it is a very complex and complicated method of designing.

Below shown is a flow chart describing the whole process schematically.

The firstmost step in the method we've used is starting the camera. This is achieved by creating a GUI first that automatically creates its own set of instructions in the editor window.

Next, we start taking the video as the input via webcam by using the videoinput('winvideo',1) function and we specify the image type as 'rgb'.

Also we've set a timer with value equal to 0.05 second that allows the system to capture the image at every 0.05 second. Thus, the input looks like a continuous video to the user.

Next, comes the object detection part that determines which object's distance is to be calculated from the webcam. In our method, we've detected the distance of the whitest object available in the image. For this we've compared the colour of the different objects available in the screen with that of default UicontrolBackgroundColor which is white in windows operating system.

Now after the object has been detected by the system, we now a place a condition using the if else statement. This condition is described as follows:

1) If the width and height of the object which is given by the variables w & h is detected to be zero, this means that the object is placed at a distance that is less than 20 cm from the webcam. This happens because the range of any camera for a clear picture starts after 20 cm of distance. That is why it is mentioned to keep the object at a distance greater than 20 cm. So, in this case, the output comes out to be zero.
2) Next comes the condition that if the width and height are detected to be greater than zero, then calculate the depth of the object from the webcam using the standard formula given by the equation:

D= (-10.73*log(area/factor)*21720)+127.38

Various functions that we have used in the program can be described as below:

1) functionMyCam_OpeningFcn(hObject, eventdata, handles, varargin): This function executes just before MyCam is made visible. This function has no output arguments.
2) functionstartcam_Callback(hObject, eventdata, handles): This function executes on button press in startcam.
3) functionDistance_obj_Callback(hObject, eventdata, handles): The command get(hObject,'String') returns contents of Distance_obj as text str2double(get(hObject,'String')) returns contents of Distance_obj as a double.
4) functionDistance_obj_CreateFcn(hObject, eventdata, handles): This function executes during object creation, after setting all properties. Edit controls usually have a white background on Windows.
5) functionDistance_Callback(hObject, eventdata, handles): This function executes on button press in Distance.
6) function [ ] = CalcDistance(video,dist): This function just captures the image.
7) [w h mincminf] = GetWidthHeight(video): This draws the rectangle on the object and presents the distance.
8) functioncalibrateBtn_Callback(hObject, eventdata, handles): This function executes on button press of calibrate button.
9) functioncameraGUI_CloseRequestFcn(hObject, eventdata, handles): This function Executes when user attempts to close cameraGUI.

## III. Result

The massive technological advancements around the world have created significant challenging competition among companies where each of the companies tries to attract the customers using different techniques. One of the recent techniques is Depth Estimation. The depth estimation is a new technology which is capable of presenting possibilities that are difficult for other technologies to offer and meet. Nowadays, numerous image processing applications have been used in the industry of different kinds and disseminated all over the world. Image processing will really alter the way individuals view the world. Image Processing is yet in its initial phases of research and development at different colleges and high-tech institutes. Besides, MATLAB begins to occupy its place in our audio-visual media and to be used in various fields in our life in tangible and exciting ways such as news, sports and is used in many domains in our life such as electronic commerce, promotion, design, and business. . In addition, image processing is used to facilitate the learning whereas it enables students to access locationspecific information provided through various sources. Growing interest in biometric authentication National ID cards, Airport security (MRPs), Surveillance .Fingerprint, iris, hand geometry, gait, voice, vein and face. Depth estimation has numerous applications specially in defence sector including the RADAR system in order to determine the aircrafts and other objects. This technology is in its initial phase but in the future this can also be used to design or determine the objects with its complete dimensions located within the environment or in a house or in a building.

Such growth and spread of image processing applications pushes organizations to compete one another, every one of them exerts its best to gain the customers.

In our case we have built a program with the help of a software system which allows a user to manipulate an obstacle without actually seeing the real environment and hence helps a user to navigate in case of temporary loss of vision or in case when environment is not suitable for humans. In our system we have designed a program which measures the depth of an object in front of the webcam that can be integrated with a hardware and thus can be used in various security and safety systems. The system measures the distance in real time in units of centimeters.

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