VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belagavi - 590 018, Karnataka

Real Time Object Measurement

A Report submitted in partial fulfillment of the requirements for the Course

Project Work for Machine Learning

(Course Code: 22AM5PWPML)

In the Department of

Machine Learning

(UG Program: B.E. in Artificial Intelligence and Machine Learning)

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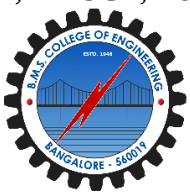

DEPARTMENT OF MACHINE LEARNING

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March - 2023

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CERTIFICATE

This is to certify that Mr. ***Tarigopula Sai Shashant*** **,** Mr. ***Bhanu Kiran T*****,** Mr. ***B.S.S Harshavardhan*** **,** Mr. ***Deeraj R*** bearing USN: ***1BM20AI051, 1BM21AI400*****,** ***1BM21AI401*****,** ***1BM21AI403*** has satisfactorily presented the Course – ***Project work on Machine Learning*** (Course code: **22AM5PWPML)** with the title ***"Real Time Object Measurement"*** in partial fulfillment of academic curriculum requirements of the 5th semester UG Program – B. E. in Artificial Intelligence and Machine Learning in the Department of Machine Learning, BMSCE, an Autonomous Institute, affiliated to Visvesvaraya Technological University, Belagavi during March 2023. It is also stated that the base work & materials considered for completion of the said course is used only for academic purpose and not used in its original form anywhere for award of any degree.

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External Examination

Examiner Name and Signature

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CHAPTER 1

INTRODUCTION

Real-time object detection and measurement is an important application of computer vision that allows machines to recognize and locate objects in real-time video streams. Canny Edge Detection is a popular algorithm used for edge detection in computer vision. It is an algorithm that detects edges in an image by analysing the gradient of the intensity values of each pixel.

The use of Canny Edge Detection Algorithm for real-time object detection and measurement involves a multi-step process that includes image pre-processing, object detection, and object measurement. The first step involves pre-processing the image to improve the quality of the image and reduce noise. The second step involves using the Canny Edge Detection algorithm to detect edges in the image. The third step involves object detection where the detected edges are used to identify the object in the image. The final step involves object measurement where the size and dimensions of the object are determined based on the detected edges.

Real-time object detection and measurement using the Canny Edge Detection Algorithm has many applications, including autonomous vehicles, security and surveillance, and robotics. The ability to accurately detect and measure objects in real-time allows machines to make informed decisions and take appropriate actions based on their environment.

1.1 About the Domain

Real-time object detection and measurement is a fundamental problem in computer vision that involves detecting and localizing objects of interest in real-world environments. This problem is particularly challenging due to the complexity and variability of the real-world environments, such as variations in lighting conditions, scale, orientation, and occlusion. Additionally, the task requires that the system operate in real-time, with low latency and high accuracy, making it a critical component in many applications, including autonomous vehicles, security and surveillance, and robotics.

One approach to real-time object detection and measurement is to use edge detection algorithms, such as the Canny Edge Detection Algorithm. Edge detection algorithms work by identifying abrupt changes in intensity values in an image, which are often associated with the boundaries of objects. The Canny Edge Detection Algorithm is a popular and widely used edge detection algorithm that uses a multi-stage process to identify edges in an image. The algorithm involves smoothing the image, calculating the gradient of the image, suppressing non-maximum gradients, and finally applying hysteresis thresholding to obtain the final edge map.

However, using the Canny Edge Detection Algorithm for real-time object detection and measurement presents several challenges. One challenge is selecting appropriate parameters for edge detection that can balance sensitivity and specificity, while also avoiding noise and false positives. Additionally, the system should be able to handle a large number of objects and operate in real-time, with low latency and high accuracy. To address these challenges, researchers and practitioners in computer vision have developed various techniques, such as machine learning and deep learning, to improve the accuracy and efficiency of real-time object detection and measurement systems.

Overall, real-time object detection and measurement using the Canny Edge Detection Algorithm is an important and challenging problem in computer vision, with many applications in various fields. Effective solutions to this problem can improve the performance and safety of autonomous vehicles, enhance security and surveillance systems, and enable more sophisticated and intelligent robotics.

1.2 Objective

The objective of using Canny Edge Detection Algorithm for real-time object detection and measurement is to improve the efficiency and optimize the accuracy of the system. The efficiency of the system refers to its ability to process large amounts of data in real-time with low latency and minimal computational resources. The accuracy of the system refers to its ability to correctly detect and measure objects in real-world environments with high precision and minimal false positives.

To achieve this objective, researchers and practitioners in computer vision use various techniques to optimize the performance of the Canny Edge Detection Algorithm. One approach is to tune the algorithm's parameters to achieve the desired sensitivity and specificity for edge detection while minimizing noise and false positives. Another approach is to use advanced image processing techniques, such as image segmentation and feature extraction, to improve the accuracy of object detection and measurement.

Moreover, machine learning and deep learning techniques can be used to optimize the efficiency and accuracy of the system. These techniques involve training models on large sets to learn the patterns and features associated with different objects, and then using the learned models to detect and measure objects in real-time video streams.

Overall, the objective of using Canny Edge Detection Algorithm for real-time object detection and measurement is to develop a robust and efficient system that can accurately detect and measure objects in real-world environments with high precision and minimal false positives. Achieving this objective requires a combination of advanced image processing techniques, machine learning, and deep learning methods to optimize the performance of the Canny Edge Detection Algorithm.

1.3 Scope

The scope of using Canny Edge Detection Algorithm for real-time object detection and measurement is vast, as it has many potential applications. One of the primary applications is in the field of autonomous vehicles, where real-time object detection and measurement are critical for safe and efficient navigation. For example, using Canny Edge Detection Algorithm, we can detect and measure objects such as vehicles, pedestrians, and road signs, which can help the autonomous vehicle make informed decisions and avoid accidents.

Moreover, real-time object detection and measurement using Canny Edge Detection Algorithm can also be used in robotics, where it can enable robots to interact with their environment and perform various tasks, such as object manipulation and navigation.

Overall, the scope of using Canny Edge Detection Algorithm for real-time object detection and measurement is broad and has many potential applications. The development of robust and efficient systems that use this algorithm can improve the performance and safety of various applications and enable more sophisticated and intelligent machines.

1.4 Motivation

The motivation behind using Canny Edge Detection Algorithm for real-time object detection and measurement is to develop intelligent systems that can recognize and locate objects in real-world environments. The use of such systems has numerous applications in various fields, including autonomous vehicles, security and surveillance, and robotics.

By using Canny Edge Detection Algorithm, we can efficiently detect the edges in an image and use them to identify and measure objects, which can improve the performance and safety of these applications.

1.5 Organization of the report

- **Introduction**: Provide background information on the topic of Background information on real-time object measurement and the use of Canny edge detection algorithm for this purpose.
- **Literature Review**: Overview of the existing literature on real-time object measurement and Canny edge detection algorithm. Discussion of the strengths and weaknesses of the algorithm.
- **Methodology**: Detailed description of the methodology used for the experiment, including the software and hardware tools used. Description of the data used and its preparation..
- **Results**: Presentation of the results obtained from the experiment, including the accuracy of the measurements.Discussion of the findings and their implications..
- **Discussion**: Compare and contrast the findings of the study to previous research in the field. Discuss the limitations of the study and suggest areas for future research.Provide practical recommendations for mental health prediction based on the study's results.
- **Conclusion**: Summarize the key findings and their implications for Object measurement prediction. Reiterate the importance of the study's results and suggest potential next steps for future research.
- **References**: Provide a list of sources cited in the report.

CHAPTER 2

RELATED WORK

- "Akash Rane, Isha Jagtap, Shravya Mapari, Prof. M. B. Yelpale /Application For Real Time Object Measurement /2022"
- "Prof. Neha Mogre, Shreyash Bhagat, Kartik Bhoyar, Harshal Hadke, Praful Ingole/ REAL TIME OBJECT DETECTION AND HEIGHT MEASUREMENT / 2022"
- "Dr. M.Mahesh, Varun Reddy, Abhishek Reddy, Charan Reddy/OBJECT DETECTION AND DIMENSIONING USING OPENCV/2022"
- "Realtime Object's Size Measurement from Distance using OpenCV and LiDAR, 1Dr. Bhavesh R. Patel, 2Sachin A. Goswami, 3Preyash S. KaPatel, 4Yash M. Dhakad , Turkish Journal of Computer and Mathematics Education, Vol.12 No. 4 (2021),1044-1047"
- "Sharma, Aaditya & Singh, Ajay & Kumari, Vinita. (2022). Real Time Object Dimension Measurement. 10.13140/RG.2.2.17442.71361"

Since the development of AI and IOT in the field of industrialisation we are keener on mechanization and quick working. Real time object measurement states that we get the measurements of the object on screen as we are watching the image in real time. Recognition of the object and its edges assumes a significant part in detecting the object.

Edge Detection is the significant stage in image processing and handling, Computer vision etc. There are quite a large number of techniques to distinguish an object and its edges. Edge Detection, which is the main field in the field of Computer vision, is an approach to handle an image to decide the boundaries of an object. In this project we are making use of one of the methods which we have used to identify an object and to take its estimation in a metric unit framework. We used thresholding technique which is used for exact edge recognition of the object. One of the main advantages of this methodology is that, it will reduce our job and hassle of measuring the object accurately. You simply use a webcam to know the measurements of object in a matter of seconds. All you have to do is place your object on white paper along with ArUco marker.

CHAPTER 3

OPEN ISSUES AND PROBLEM STATEMENT

Open issues

- **Object Occlusion**: When objects overlap or partially block each other, it can be difficult for the system to accurately measure them. Addressing this issue will require the development of advanced algorithms that can accurately detect and measure partially occluded objects.
- **Accuracy and Precision**: Achieving high levels of accuracy and precision in real-time object measurement systems can be challenging, especially when measuring small or complex objects.
- **Environmental Factors**: Real-time object measurement systems can be affected by environmental factors such as lighting conditions, temperature, and humidity. Developing systems that are robust to these factors will be an important area of future research.
- **Threshold selection**: One of the main challenges in using Canny Edge Detection is selecting the appropriate threshold values to detect edges. If the threshold is too high, important edges may be missed, while a low threshold may result in the detection of many false edges
- **Multi-Object Measurement**: Real-time object measurement systems often need to measure multiple objects simultaneously. Developing systems that can accurately measure multiple objects in real-time is an important area of research.

Problem Statement

Canny edge detection method which has received much attention during the recent years due to its many applications in different fields. Edge detection is one of those challenging problems and up to date, there is no technique that provides a robust solution to all situations and different applications that edge detection method may encounter.

Real time object detection and measurement is a technically very challenging problem in area of computer vision. Object detection works by identifying the presence of object in video camera or in a image. An objects or human’s physical dimensions such as an object’s height,

body width and length are essential bases for identifying an object in a video camera. As many research is done in this field of object detection and measurement between the last two decades.

Object detection and measurement involves machine learning, image processing optimization and secondary numerical data. There are various types of objects detection algorithm. R-CNN, Retina-Net, and Single-Shot Detector (SSD). These are methods have solved challenges and modelling in object detecting. Here we use the YOLO detection algorithm for detecting the objects. For the measurement of the Objects, we use OpenCV. With help of reference point which is created by bounding box grid, it calculates the height and width of the object

CHAPTER 4

DATA COLLECTION AND VALIDATION

Data collection

Describe the process of collecting data for the experiment, including the equipment used and any necessary preparation. Discuss any challenges or limitations encountered during the data collection process.

Explain the importance of validating data in the context of real-time object measurement using the Canny edge detection algorithm. Describe the methods used to validate the data collected for the experiment. Discuss any issues encountered during the data validation process and how they were addressed.

Summarize the importance of proper data collection and validation in real-time object measurement using the Canny edge detection algorithm. Highlight any key findings or insights gained from the data analysis process. Provide recommendations for future research in this area.

Validation

Validation is a critical step in machine learning projects to ensure that the model's performance is reliable and accurate. There are several types of validation techniques that can be used depending on the nature of the project and the available data. Here are some of the most commonly used validation techniques:

- **Cross-validation:** This technique involves partitioning the data into multiple subsets and using each subset in turn for both training and testing the model. This approach helps to reduce the variance of the model by testing it on different subsets of data.
- **Holdout validation:** This technique involves splitting the data into two sets: one for training the model and another for testing the model. Typically, the training set is larger than the testing set, and the model is evaluated on the testing set after it has been trained on the training set.
- **Leave-one-out cross-validation:** This is a special case of k-fold cross-validation where k is equal to the number of samples in the data. This approach is particularly

useful when the data is small, and it helps to ensure that every sample is used for testing at least once.

- **Bootstrapping:** This technique involves randomly sampling the data with replacement and using each sample to train and test the model. This approach is useful when there is limited data available, and it helps to estimate the model's performance and uncertainty.
- It is important to note that validation alone cannot guarantee the accuracy of a machine learning model. It is essential to use appropriate data cleaning and pre-processing techniques, select relevant features, choose appropriate algorithms, and tune the model's hyperparameters to achieve optimal performance.

CHAPTER 5

DETAILED DESIGN

5.1 Proposed Architecture

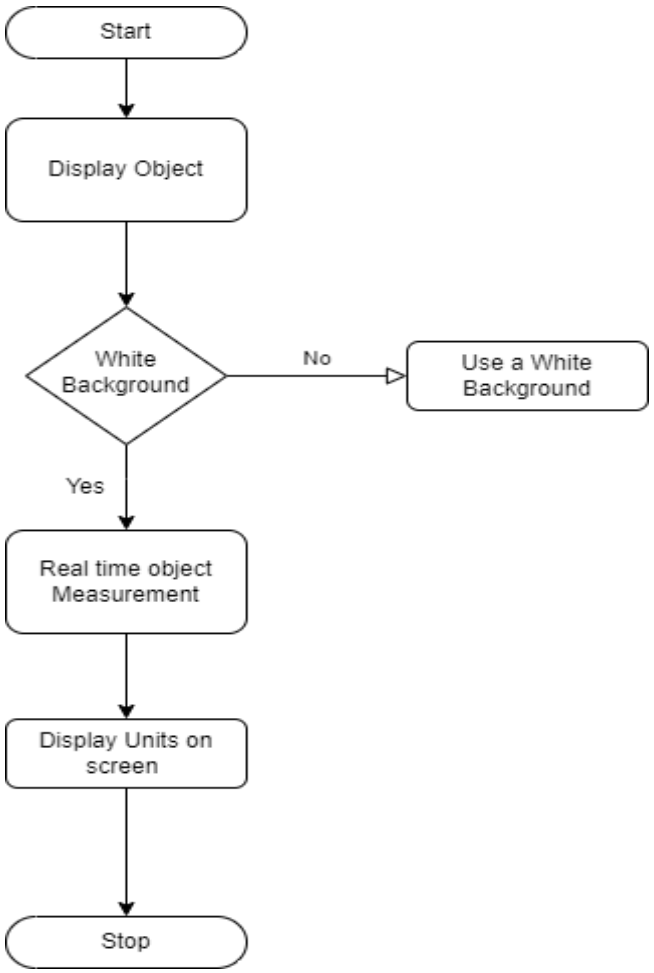

Fig 1.1 Project Flow

5.2 Functional and Non-Functional Requirements

Functional requirements are specific actions or behaviors that a system should be able to perform. Some potential functional requirements for a mental health prediction system might include:

- Object detection: The system should be able to detect objects in real-time, even in low-light or high-contrast situations.
- Dimension measurement: The system should be able to accurately measure the dimensions of objects, including length, width, height, and depth.
- Handle objects with complex shapes, including partially occluded or partially reflective objects.
- Visual feedback to the user on the detected objects and their measurements.

Nonfunctional requirements are constraints or characteristics of a system that don't relate directly to specific functions, but that still need to be satisfied in order for the system to be useful. Some potential nonfunctional requirements for a mental health prediction system might include:

- Accuracy: The system should be able to provide accurate measurements, with a high degree of precision.
- Robustness: The system should be robust to changes in lighting conditions, object occlusions, and background clutter.
- Security: The system should be secure and protect sensitive data, such as measurements and object images, from unauthorized access.
- Usability: The system should be easy to use, with a user-friendly interface that allows users to configure and monitor the system.

5.3 Methodology

Canny Edge Detection is a widely used edge detection algorithm that is designed to detect edges in an image while minimizing the detection of false edges. The algorithm consists of several steps:

- **Gaussian smoothing**: The first step in the Canny Edge Detection algorithm is to smooth the image using a Gaussian filter. This step is important because it reduces the amount of noise in the image and makes it easier to detect edges.

- **Gradient calculation**: Next, the gradient magnitude and direction of the image is calculated. The gradient magnitude represents the strength of the edge, while the gradient direction indicates the orientation of the edge. Non-maximum suppression: In this step, the algorithm removes pixels that are not local maxima along the gradient direction. This step helps to reduce the number of false edges and ensure that only the strongest edges are detected.

- **Hysteresis thresholding**: The final step in the Canny Edge Detection algorithm is to apply a threshold to the gradient magnitude to determine which pixels are considered to be edges. This step is done in two stages: a high threshold is applied to identify strong edges, and a low threshold is applied to identify weak edges that are connected to strong edges. The weak edges that are not connected to strong edges are discarded.

- The results of the Canny Edge Detection algorithm are thin, well-defined edges that accurately represent the boundaries of objects in the image. The algorithm is known for its ability to detect both weak and strong edges, reduce noise, produce clear and thin edges, and its robustness to changes in image brightness and noise.

- Canny Edge Detection is widely used in a variety of applications, including object detection, image segmentation, and computer vision. The algorithm can be implemented in software or hardware, and can be optimized for real-time performance in a variety of environments.

5.4 Implementation

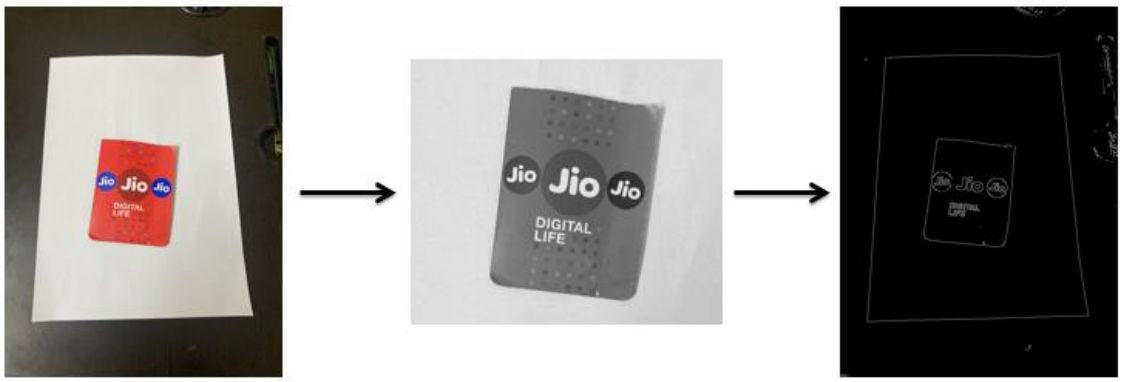

Fig 1.2 Implementation

The Canny edge detection algorithm is a popular algorithm used for edge detection in image processing. It was developed by John F. Canny in 1986. The algorithm involves the following steps:

- **Gaussian Blur**: The first step is to apply a Gaussian filter to smooth out any noise in the image.
- **Gradient Calculation**: The next step is to calculate the gradient of the image using the Sobel operator, which detects edges in both the horizontal and vertical directions.
- **Non-maximum suppression**: The third step is to perform non-maximum suppression to thin out the edges and ensure that only the strongest edges are retained.
- **Double thresholding**: The fourth step is to perform double thresholding to classify the edges as strong, weak, or non-edges.
- **Edge tracking by hysteresis**: The final step is to perform edge tracking by hysteresis to connect the weak edges to the strong edges and form continuous edges.

5.5 Data Flow and Control Flow Sequence

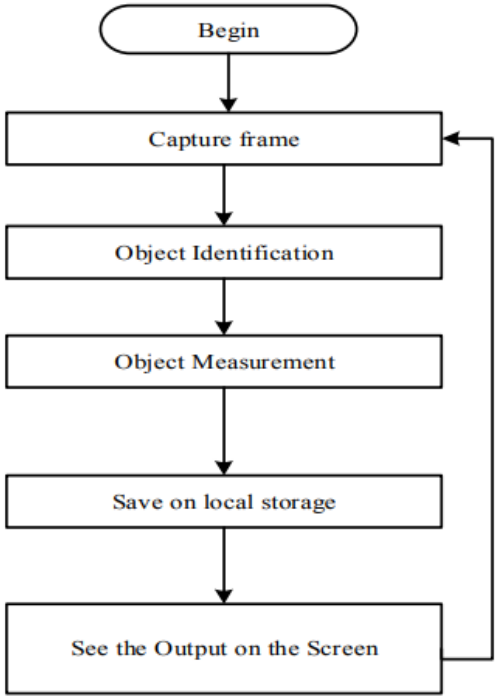

Fig 1.3 Control flow

- Threshold selection is a crucial step in the Canny Edge Detection algorithm. The purpose of thresholding is to identify edges in an image by separating the pixels that are part of an edge from the pixels that are not.
- In Canny Edge Detection, the thresholding is done in two stages. First, the gradient magnitude of the image is calculated, and then, a threshold is applied to the gradient magnitude to determine which pixels are considered to be edges.
- The threshold values are chosen to ensure that the edges in the image are detected while minimizing the detection of false edges. If the threshold is set too low, the algorithm will detect many false edges, while if it is set too high, important edges may be missed.
- The choice of threshold values can have a significant impact on the accuracy and performance of the algorithm, so it is important to carefully select the threshold values to ensure that the algorithm is able to accurately detect edges in an image.
- There are several methods for selecting the threshold values in Canny Edge Detection, including using a fixed threshold value, using a dynamic threshold value based on the image properties, or using multiple threshold values to detect different levels of edges. The choice of method depends on the characteristics of the image and the desired edge detection results.

5.6 Testing and Validation

TEST CASE	GIVEN INPUT	EXPECTED OUTCOME	OBTAINED OUTCOME
Test Case 1	Mobile Phone	Height = 8.4cm Width = 16.2cm	Height = 8.3cm Width = 16.2cm
Test Case 2	Visiting Card	Height = 5.2cm Width = 9.2cm	Height = 5.2cm Width = 9.2cm
Test Case 3	Non-quadrilateral	Height = 10.2cm Width = 10cm	Height = 10.2cm Width = 9.9cm

Testing and validation

- When developing a machine learning model for identifying objects using Canny edge detection and morphological operators, it is important to perform testing and validation to ensure that the model performs accurately and consistently on new data.
- Testing involves using a set of data that was not used during the training phase of the model to evaluate its performance. This data should be representative of the real-world data that the model will be used on. In this case, the testing data could be a set of images that are similar to the images used during training, but that were not used during training.
- Validation involves evaluating the performance of the model during the training phase to ensure that it is not overfitting or underfitting. Overfitting occurs when the model is too complex and performs well on the training data but poorly on new data, while underfitting occurs when the model is too simple and does not capture the patterns in the data.
- To validate the model, we have split the training data into a training set and a validation set, and train the model on the training set while evaluating its performance on the validation set. This allows us to make adjustments to the model if necessary to improve its performance.
- Once the model has been tested and validated, we can evaluate its accuracy. In this case, the accuracy of the model is 99% after testing, it means that the model correctly identifies the object in 99% of the cases. However, it is important to note that accuracy is just one measure of the performance of a machine learning model and it may not be sufficient for all applications. Other measures such as precision, recall, and F1-score may also be useful in evaluating the performance of the model.

CHAPTER 6

RESULTS AND DISCUSSION

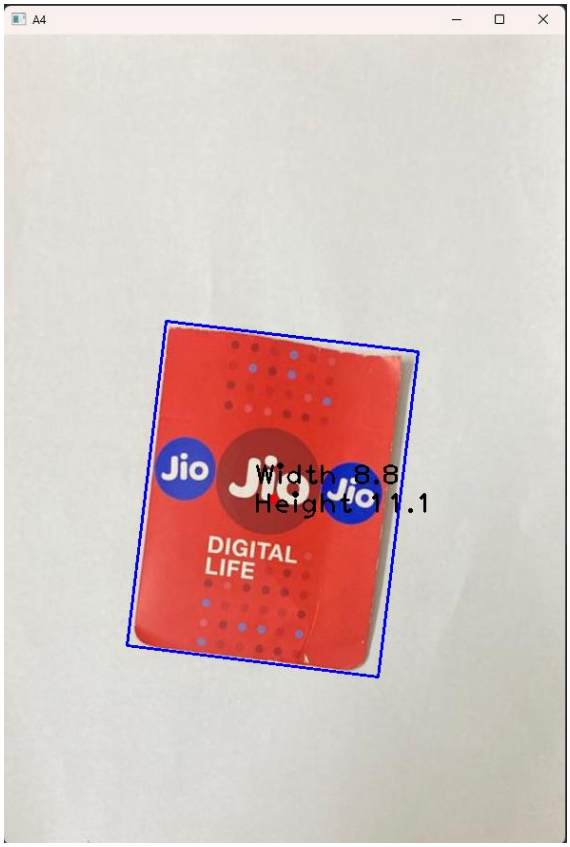

Fig 1.4 Rectangle

Fig 1.5 Visiting Card

Fig 1.6 Non-Quadrilateral

In this study, a powerful real time object measurement method is proposed. In the offered system, Computer Vision used to detect and measure objects. The system can detect and measure objects in a real time. After the object has been detected by using canny edge detector, the size is obtained for each object. We enhanced the canny edge detector algorithm through utilizing Morphological operations

Overall, the Canny edge detection algorithm and morphological operators are powerful tools that can help accurately identify and measure objects in digital images. By following a series of well-defined steps and using appropriate image processing techniques, it is possible to achieve accurate and reliable results when measuring objects using the Canny edge detection algorithm.

CHAPTER 7

CONCLUSION AND FUTURE ENHANCEMENT

In conclusion, real-time object detection and measurement is an important area of research with a wide range of applications. Canny Edge Detection has proven to be a reliable and effective algorithm for this task, due to its ability to detect both weak and strong edges, reduce noise, produce clear and thin edges, and its robustness to changes in image brightness and noise.

However, there is always room for improvement, and there are several areas where future research could lead to further advancements in this field. Some potential areas for future research include:

Improving the accuracy and speed of the algorithm: Researchers could investigate ways to further, improve the accuracy and speed of the Canny Edge Detection algorithm, making it even more reliable and efficient for real-time object detection and measurement.

Further advancements:

- Improving the accuracy of the project.
- Developing new techniques for object detection and measurement by using more reliable reference object

REFERENCES

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