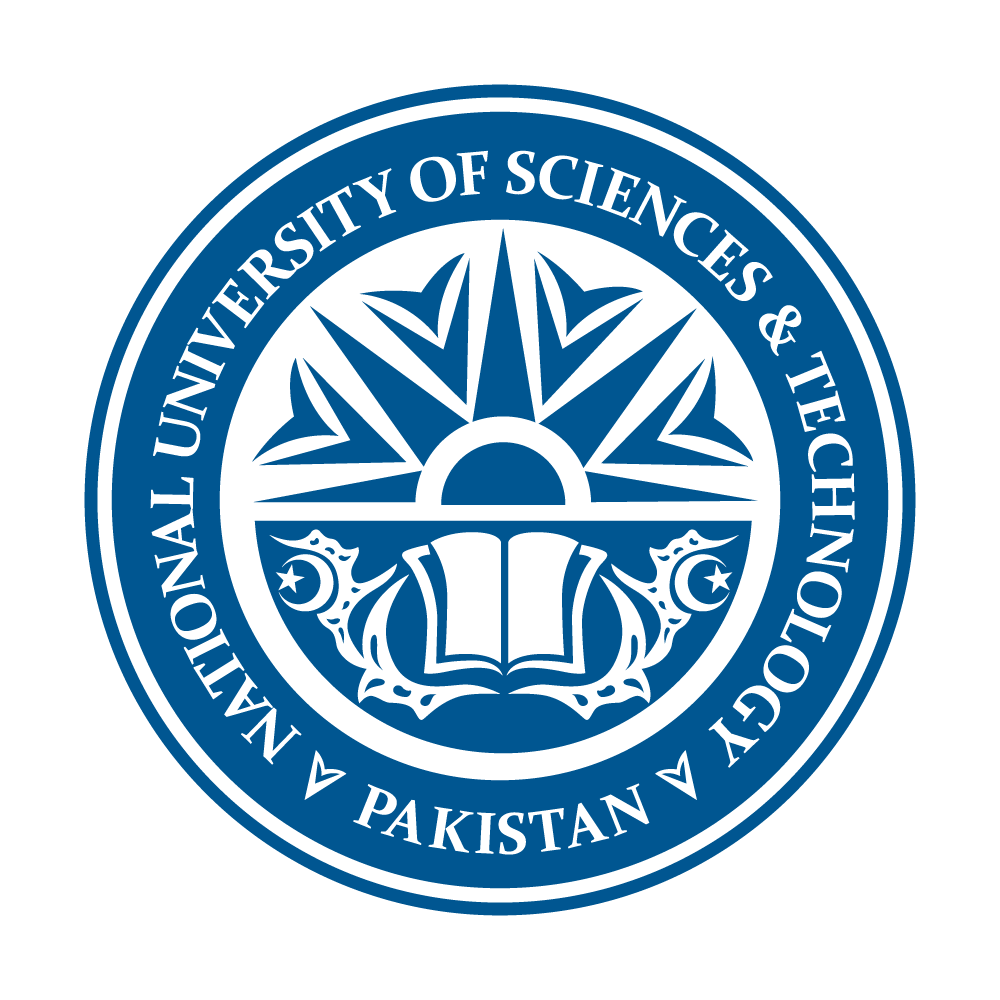
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**Traffic Sign Recognition for Autonomous Driving: A Comparative Study of SIFT, ORB, and YOLO Algorithms**

Table of Contents

[Introduction 1](#_Toc164865472)

[Scale-Invariant Feature Transform (SIFT) 1](#_Toc164865473)

[Oriented FAST and Rotated BRIEF (ORB) 1](#_Toc164865474)

[You Only Look Once (YOLO) 1](#_Toc164865475)

[Algorithm Selection 2](#_Toc164865476)

[Criteria for Evaluation 2](#_Toc164865477)

[Environmental Impacts 2](#_Toc164865478)

[Experimental Setups 2](#_Toc164865479)

[Conclusion 2](#_Toc164865480)

## Introduction

Traffic sign recognition (TSR) is a crucial component of autonomous driving systems, enabling safe and efficient navigation on the road. This report analyzes the working of mobile in TSR, focusing on three main algorithms: SIFT, ORB, and YOLO. These algorithms were tested on the TB3 platform, and their performance was evaluated based on accuracy, overall-accuracy, and computational time.

## Scale-Invariant Feature Transform (SIFT)

The SIFT algorithm is a machine learning algorithm used to extract features from a given image. It can extract key points even from the smallest image and is not affected by the scale or rotation of the image. The traffic signs are automatically annotated by the SIFT algorithm, without the need for human or manual intervention. This is advantageous compared to R-CNN and YOLO. The method is not significantly affected by image size, lighting conditions, or rotation. The main issue with TB3 and SIFT is that it requires an image of the same quality as the reference image.

## Oriented FAST and Rotated BRIEF (ORB)

ORB may be employed as an alternative to the SIFT algorithm, resulting in improved efficiency. ORB is constructed using established FAST key point detection and BRIEF descriptors. Because the FAST method is utilized, key points can be detected more rapidly and efficiently with the aid of the BRIEF descriptor. This modified version of the FAST key point decider is used for vision tasks and has superior key point detection abilities compared to the SIFT algorithm. When combined with the BFMatcher, it is suitable for traffic sign recognition. Additionally, it is a quick algorithm that requires less computational time than others. However, it operates differently in various environments (background dependency), best performance is reached by using the same environment as the reference image.

## You Only Look Once (YOLO)

YOLO is a real-time object detection system that is known for its high accuracy and low computational time. It is currently considered to be the swiftest and most precise algorithm for identifying objects. However, it has a drawback - while training a custom dataset, it requires a significant amount of memory and storage space.

## Algorithm Selection

Considering the task and with brief analysis on each algorithm of interest, YOLO and ORB might be good fit and can be tested/ compared further along with SIFT. Reason for choosing YOLO is the promising accuracy shown in various applications with low computational time, and ORB might be a more comparable approach but better version of SIFT as it is said to be faster than SIFT and more accurate also. R-CNN is highly accurate but when working with real-time systems, it cannot be used as it is having two stage detection which affects the time used for detection of sign adversely. But along with YOLO and ORB, SIFT will also be implemented as it is the default algorithm for comparison. Furthermore, combinations of these three algorithms are possible and might also be implemented for test, such as YOLO with SIFT or YOLO with ORB.

## Criteria for Evaluation

To assess the efficiency of the algorithms, specific criteria must be established: 1) Accuracy for each individual sign; 2) Overall-accuracy for all signs; 3) Calculation/ processing time (Computational performance and Complexity). Judgement shall be done by TP, TN, FP, FN as with these four categories all the possible outcome can be measured and placed in at least one of these categories, which is helpful to determine the accuracy of the system.

## Environmental Impacts

Environmental impacts, such as lighting conditions and sign positioning, are crucial factors to consider when testing the accuracy of each sign individually as well as collectively. Testing should be conducted while keeping environmental constraints in mind, such as varying illumination conditions and sign placement on the right, left, top, bottom, near, or far.

## Experimental Setups

The algorithms are tested on the TB3 using multiple test-cases, each with its own significance for fulfilling different criteria. These include On-Table and Mini-City-Track tests, environment independence, dynamic positioning, track range, and computational power testing.

## Conclusion

This report analyzed the working of mobile in TSR, focusing on the SIFT, ORB, and YOLO algorithms. The algorithms were tested on the TB3 platform, and their performance was evaluated based on accuracy, overall-accuracy, and computational time. The results showed that YOLO and ORB were suitable algorithms for TSR, with YOLO demonstrating the highest accuracy and ORB being a faster and more accurate version of SIFT. The environmental impacts, such as lighting conditions and sign positioning, were also considered during the testing process. Overall, this report provides a comprehensive analysis of the SIFT, ORB, and YOLO algorithms for TSR in autonomous driving systems.