Helmet Detection and Reporting System

Adarsh Y Ulvekar[1], Pavithra T S[2]
Department of Computer Applications, PES University
Bangalore, India
[1]adarshulvekar49@gmail.com
[2]pavithrats@pes.edu

Abstract: As previous research showed that helmet plays an important part in road safety by decreasing the likelihood of head injuries it is a consistent feature. Sensors, which detect riders who are not wearing Helmet can contribute to the detection of riders who are not wearing Helmet. This can lead to enhancing of helmets among the motor-cycle users as well as minimizing motorcycle related accidents. This System will take the snap of the rider with no helmet then they record the details of vehicle and the report which will contains the snaps, vehicle number, name, phone number, address etc. This report is for the traffic controller, the generated will also be issued to the rider.

Keywords: CNN, easyOcr, YOLO v5, OpenCV, PyTorch.

I. INTRODUCTION:

Lack of Traffic inspector at the scene of the incident. With regard to the existing predicaments, one of the most alarming issues is the lack of traffic inspectors or policemen in critical areas that can witness the violation of the rules. Without realization and physical appearance of authority, it becomes so challenging to check compliances of every one to every traffic regulation in existence. Self-observation on the vehicle, over the car or the bike, on foot and any other manner of travelling. Through human error and fatigue, there may be a tendency not to see or enforce the violations sufficiently. The rider has no knowledge of the rule that a hearer has violated. With regards to helmet rule breakage, many riders may not even know the actual traffic laws they are violating while on the roads.

This is built to assess real-time input video clips taken from surveillance cameras or monitoring devices where motorcycle riders are on the road. Features such as license plate extraction and license plate recognition are active only when it is identified that there is non-compliance to helmets. They added that once the system identifies a rider who is not wearing a helmet, the license number plate of the vehicle is obtained from the video stream. System performance considerations. Despite its high accuracy level of the system and efficient way of working, the system is not 100 percent accurate, meaning that there may be circumstances that the system will not read the license plate, poor lighting at night, or obscured views of the car. The crucial dependence on information about vehicles in the XML. This means that for successful extraction and retrieval of information on the vehicles such as the owners, adequate and good data needs to be present in the XML of the system. Speaking of the data handling, it is necessary to turn attention to the point that its analysis should be carried out using the WHOLE data set, not every individual element of it. Hence, when holding the sensitive information that the system captures and processes, privacy is of the essence. There should be legal compliance on policies of data protection since personal information regarding the rider's details is contained in the XML.

To encourage the use of motorcycle helmets as well as the cutting down of number of accidents and deaths resulting from misuse of motorcycle helmets. The hope with this approach would be to improve the level of enforcement and compliance with the helmet laws through the use of the proposed helmet violation detection solution. In order to facilitate enforcement processes and minimize the work of law enforcement when it comes to detaining helmet violators. Computer vision and deep learning technologies used in the development of the solution free up time that was previously spent monitoring and enforcing helmet non-compliance through the provision of automating the detection of helmet non-compliance incidents. To further develop the still relatively young field of traffic management and improve the conditions of the transport environment through the application of technologies. The solution formulated in this article exhibits an astounding improvement in the management of traffic using innovative technologies to meet the formulation of road safety concerns. In fostering the use of technology-driven approaches, the solution helps to achieve the enhancement of a safer transport environment, defined by the provision of the minimum levels of accidents, observation of traffic laws and the general improvement of transport safety.

Across all the two-stage algorithms that have been discussed in this paper which includes the faster R-CNN and the Mask R-CNN, it has been noted that they tend to exhibit very high detection accuracy. However, they prove to be slower because of their multistage structure wherein real time detection is not easily achievable. Single-stage algorithms that include YOLO (YOU ONLY LOOK ONCE), RetinaNet, FCOS (FULLY CONVENTIONAL ONE-STGE OBJECT DETECTION), SSD (SINGLE SHOT DETECTOR) and RepPoints (based on anchor-free detection), ATSS (ADAPTIVE TRAINING SAMPLE SELECTION) focus more on the speed of algorithms and at the

same time are attempting to bring medium accuracy at the same age. Out of all these updates, the YOLOv5 is the latest update of this algorithm that is recognized as the fifth generation of YOLO family of algorithms and is known for its faster performance with a decent accuracy level. This makes it easy when it comes to object detection with small model sizes that could ensure real-time operations. The automatic helmet detection system has been developed using YOLOv5 detector with new tweaks known as the triplet attention.

II. LITERATURE SURVEY

Research paper [1] presents a study conducted on Helmet and Number Plate, License plate recognition and Stolen Vehicle identification by ML System. The sophisticated approach it incorporates includes video size/aspect ratio analysis, image classification using Convolutional Neural Networks, head region extraction and feature analysis, and optical character recognition. It handles CCTV video input, identifies video size and aspect ratio, CNN for content categorisation, and isolates head regions for feature extraction and OCR to obtain textual information such as number plates from videos. Its objectives is to extract real-time information on persons riding motorcycles without a helmet and details of registration number plates for license which will assist in road safety and policing.

In Research Paper [2], The real-time method for helmet detection with motorcyclists in urban traffic is described introduce a system that is based on YOLOv5 algorithm and capable of detecting motorcycles and decide whether the riders is wearing helmet or not is suitable form real-time video surveillance. Major components include Motorcycle detection by applying YOLOv5 algorithm, Helmet detection by using YOLOv5 and displaying the real-time data of detected motorcycles and helmet worn or not. This method improves traffic safety as it allows for automated and accurate monitoring of helmet confirmation.

In Research Paper [3], it explains the development of an Automatic Detection System for Motorcyclists without Helmets through employing of Machine learning. Key techniques in this model include OpenCV computing for image processing, HAAR cascade used in OCR as well as in object detection. They are the input images that the system receives and processes, the helmets that the system detects, the text such as license plate numbers that are extracted such as and the detection results that the system provides. This approach improves enforcement of safety regulations since computer is used to detect could-be offenders of helmets and number plates..

In Research Paper [4] Automatic Number Plate Detection for the motorcycle riders without helmets is proposed and presented. This model compiles the detection of helmet and the use of the number plate detection employing YOLOv5 and Tesseract OCR mechanism respectively. They pre-process images, employ built-in feature extraction to find helmets using object detection algorithms, obtain regions of interest, categorize detected helmets, and raise alerts with pyWhatkit library. This system improves safety enforcement by detecting helmet and number plate violators as well as reporting these incidences to anyone concerned.

III. PROPOSED SYSTEM

Acceptance of Recorded Video Files & Vehicle Detection. It only takes recorded video files that are supplied into the system by an admin or any other authorized personnel. From the video footage, the system identifies vehicles whereby accurate analysis differentiates between violated and non-violated vehicles. Helmet detection utilizing improved pre-trained YOLOv5 model. Integrated with the YOLOv5 which is a deep learning object detection model, the system correctly detects instances of non-compliance with the use of helmets particularly by motorcyclists. Extraction of Vehicle License Plate Number Image or simply LNP Image extraction. When an incident of helmet non compliance is detected the system identifies the license plate number image from the collected video clips. By applying various techniques in image processing and enhancing.

First it takes the video file as the input from the admin and it handed over to the model which tries to identify the presence of vehicle in the video file if vehicle is not detected by the model then it move to initial state if vehicle is detected it checks for the helmet detection level if helmet is detected then it goes for the initial state if helmet is not detected then goes for the next level.

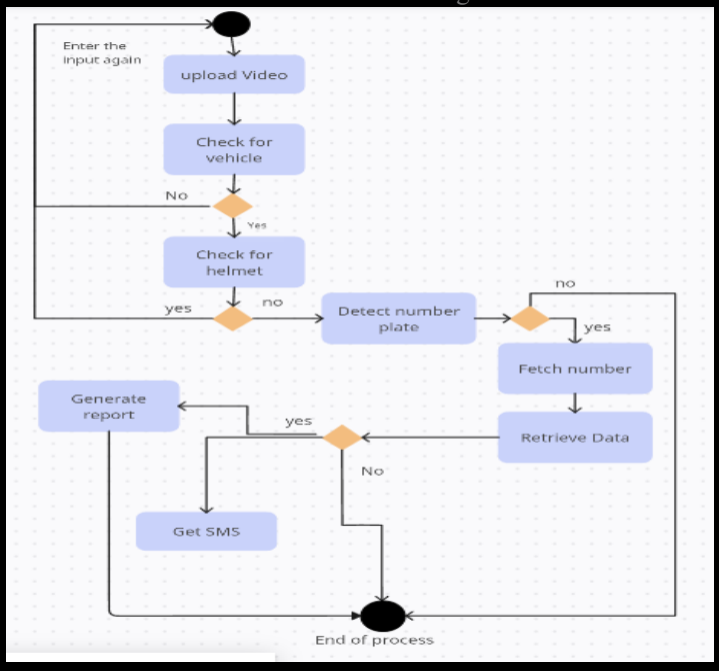

Fig 1. System Design

If the number plate was not extracted then it goes to initial state otherwise the above state is traversed into the next state. Once this number plate is extracted then it can be used to find the details from the XML as shown in the figure above. It keeps fetching thedetails and then sends it modeled into the report for the admin.

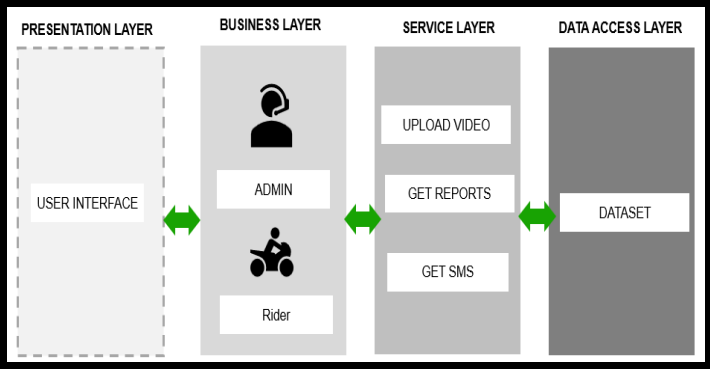

Fig 2. Architecture Diagram

It includes such components as the list of violations, where administrators can see the violations that have been detected and such a component as the 'dashboard' that allows administrators to access reports and settings. In simplistic terms, it can be understood as an external layer of any software that allows the user to interact with the services offered by the system via UI. Connects the system to the external services including handling of information received and delivery of results from the services to the system. It also stores different kinds of data such as information about the violations that were detected, riders' information, and the system settings as well with the help of a relational XML.

A. Data Collection

The data set compiled from the Roboflow website consists of a large set of images along with associated annotations that are specifically designed for object detection, which possibly targets the identification of helmets. Concerning the dataset, it should be mentioned that using Roboflow. This dataset is expected to comprise variability as they will contain pictures taken at various settings and lighting conditions pertinent to the planned application; this would help to make the trained artificial neural network more suitable for various circumstances. Moreover, Roboflow's preprocessing functionality allows practical ease in data augmentation and resizing that helps in the enhancement of the diversity of the dataset as well as the optimization of the training time.

Fig 3: Bike Dataset

Fig 4: Helmet Dataset

B. Pre-Processing

1) Image Resizing and Normalization: In the img_classify function, resize the dimensionality of the input image to 144X144 pixels using the transforms. Scaling transformation from the torchvision. transforms module. Then, resize, expand its color channels from one to three, and finally change the pixel values to the range [-1, 1] using the transforms in PyTorch. toTensor and transforms. Normalize transformations

2) Image Permutation and Conversion*:*In the object_detection function, before passing the image tensor through the YOLOv5 model, note that some deep learning frameworks, including PyTorch, have models in channels-first format, whereas input images usually come in channels-last format. To match them, call permute(2, 0, 1) on the image tensor.

3) Data Augmentation*:* System not directly performed data augmentation though employed it during training of the data in order to get diverse forms of the same data for improved performance. Similar to the above classification, some of the data augmentation operations include rotation, flipping of images as well as random cropping.

Fig 5: Pre-processing Images

C. Training Model

The training data is prepared in the YOLOv5 format, which means that an image and the associated label is provided in the format of bounding boxes around the objects of interest and its class. In the training path always consider the script assumes the data to be in the right format for training.

1) Object Detection: the algorithm reads frames from a video stream or image file and pass through the YOLOv5 model for object detection. Detected objects are classified into three categories: riders, helmets, and number plate.

2) Helmet Classification: ROI for each detected head in the first classifier and performs the helmet classification in the second classifier. Thus the script, taking into consideration the classification result, identifies the presence or absence of the helmet accordingly.

3) Saving Results: The script writes over the video by placing rectangles around the discovered objects and displaying the classification of the helmets. It also captures images of riders and their number plates if in the image search area in real-time analysis of the frame as described below.

4) Displaying Results: It also presents the script of the processed video frame by frame starting from the detection and the classification in real time.

D. Performance Evaluation

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

```
Detected: number conf: 0.67  bbox: x1:399    y1:434    x2:539    y2:477
Detected: rider conf: 0.58  bbox: x1:232    y1:44    x2:430    y2:483
Detected: head conf: 0.55  bbox: x1:434    y1:72    x2:547    y2:215
Detected: rider conf: 0.5  bbox: x1:360    y1:47    x2:638    y2:495
Detected: head conf: 0.36  bbox: x1:307    y1:49    x2:392    y2:142
Detected: number conf: 0.7  bbox: x1:394    y1:435    x2:541    y2:477
Detected: head conf: 0.64  bbox: x1:428    y1:73    x2:549    y2:221
Detected: rider conf: 0.38  bbox: x1:227    y1:30    x2:431    y2:491
Detected: number conf: 0.66  bbox: x1:390    y1:438    x2:536    y2:477
Detected: head conf: 0.58  bbox: x1:417    y1:63    x2:552    y2:228
Detected: rider conf: 0.45  bbox: x1:337    y1:45    x2:645    y2:492
Detected: rider conf: 0.44  bbox: x1:220    y1:12    x2:435    y2:471
Detected: head conf: 0.66  bbox: x1:420    y1:75    x2:541    y2:216
Detected: number conf: 0.64  bbox: x1:387    y1:440    x2:534    y2:477
Detected: rider conf: 0.42  bbox: x1:222    y1:13    x2:427    y2:466
Detected: head conf: 0.63  bbox: x1:416    y1:73    x2:546    y2:219
Detected: number conf: 0.62  bbox: x1:383    y1:439    x2:530    y2:476
Detected: number conf: 0.63  bbox: x1:380    y1:438    x2:530    y2:476
Detected: head conf: 0.6  bbox: x1:413    y1:75    x2:543    y2:223
Detected: head conf: 0.45  bbox: x1:293    y1:35    x2:394    y2:147
Detected: number conf: 0.58  bbox: x1:370    y1:437    x2:520    y2:479
Detected: head conf: 0.56  bbox: x1:406    y1:66    x2:545    y2:223
Detected: head conf: 0.44  bbox: x1:294    y1:38    x2:391    y2:144
Detected: number conf: 0.6  bbox: x1:365    y1:439    x2:519    y2:479
```

Fig 6: ROI Detection Conf

The designed model incorporate ROI method Mxy, which in turn, yields the coordinate of the identified images. Detected: rider conf: 0. 58 bbox: x1:232 y1:44 x2:547 y2:215 This line informs that for rider 1000, program has a confidence score of 0. It is not certain any studies have assessed happiness levels at this point [60% = 0. 58 (possibly out of 1. 0)], this indicates is currently the case. There is also information about the bounding box coordinates. Detected: head conf: 0. 64 bbox: x1:428 y1:73 x2:549 y2:221,477 It marks the head that has been found by the program with a confidence of 0.64.

IV. METHODOLOGY

A. Convolutional Neural Networks (CNNs)

Convolutional Neural Networks (CNNs) is a category of the neural deep networks that is employed in handling and processing image and video data. CNNs is used by their inherent flexibility to learn the spatial organization of functions given data. As for two-dimensional image H and two-dimensional filter(kernel) F

For a 2D image H and 2D Filter(kernel) F

1.) Convolution Operation: G=H * F,
G [a, b] =$\sum_{e=-r}^{r} \sum_{e=-r}^{r} H[e,v]F[a-e,b-v]$

2.) Correlation Operation: G=H Ø F,
G [a, b] =$\sum_{e=-r}^{r} \sum_{e=-r}^{r} H[e,v]F[a+e,b+v]$s

B. Open-Source Computer Vision Library (OpenCV)

It is an open-source computer vision and machine learning software library designed for real-time applications. Provides many photo and video processing features.

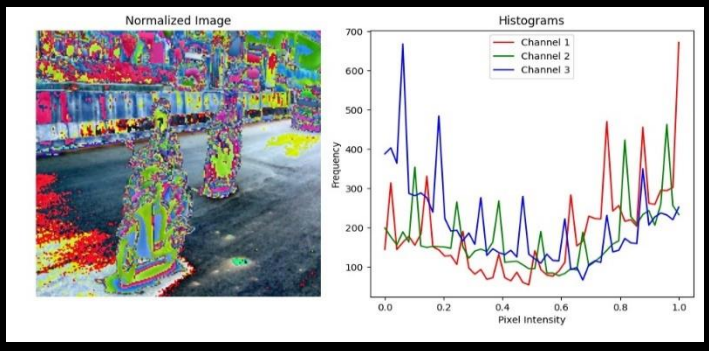

Fig 7: Sample Image

C. You Only Look Once (YOLO v5)

It is an object detection framework that has been developed based on its preceding versions (YOLO v4). The model was designed by Ultralytics and had its initial release in mid-2020. You know the meaning of this, do you? YOLO – an acronym for 'You Only Look Once',

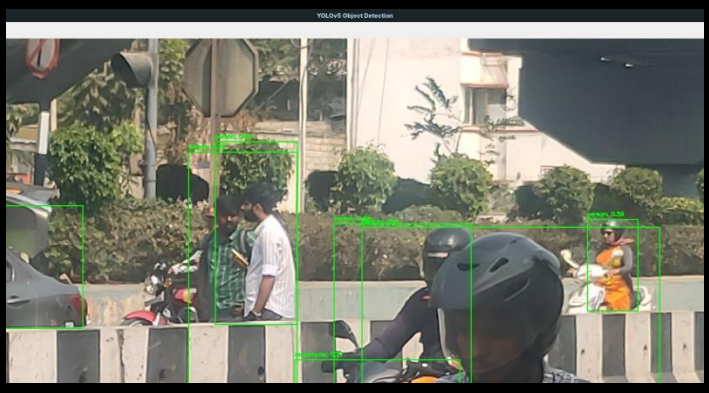

Fig 8. Bounding Box

D. PyTorch

It is also one of the most well-known framework for deep learning that is based on Python. However, there is no specific formula on which PyTorch based, but it has many concepts of math critical to deep learning. PyTorch is used to perform forward passes on helmet head areas of interest that have been preprocessed from the video frame using the helmet classification model.

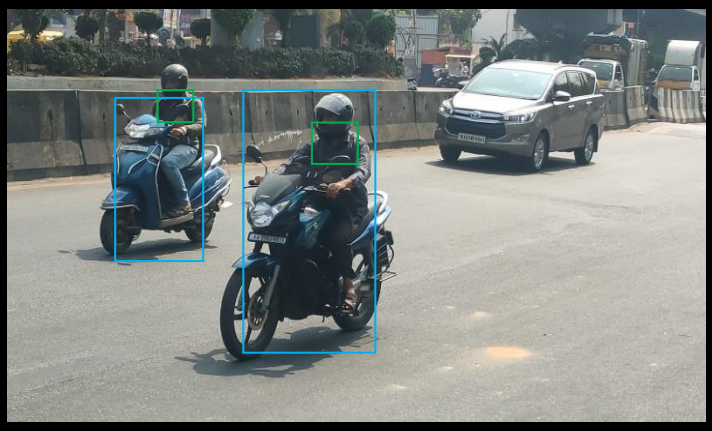

Fig 9: Head Region Extraction

E. Imutils ,NumPy, PyPlot

It's essential to have a fundamental understanding of what image processing entails, especially in Python since it's one of the main tools used today. Imutils, as a set of utility functions, builds a convenient API on top of OpenCV, facilitating basic image processing operations. NumPy the system that does all the heavy lifting in scientific computing handles numerical data vey efficaciously on which images are based. lastly, pyplot which is a library under Matplotlib receives the processed image data in the form of NumPy which then helps in converting the data into visual representations such as charts and plots.

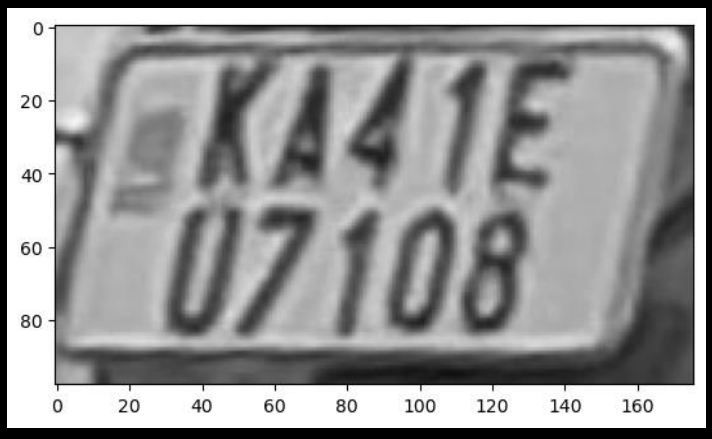

Fig. 10 Edge Extraction

F. Twilio API

Twilio is an online telephony company that puts communication services in the cloud and offers APIs so that software developers can use the services in their software products. A process to alert them of riders violating the no helmet rule through sending a message through the Short Messaging Service. Identified and created a stable helmet detection method that analyzes video stream to pin point riders who are not wearing helmets correctly.

V. RESULTS

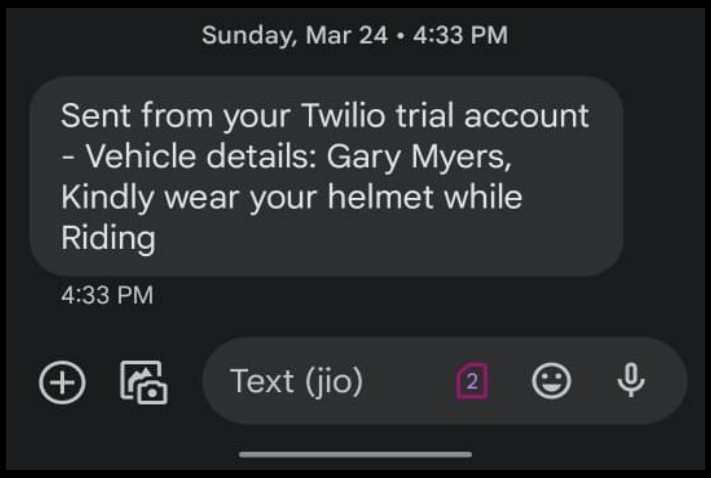

Fig. 11 Twilio Notification

In the case of a violation, the system tells the system to send an SMS on the rider's phone number that the rider violated a particular regulation. It is crucial to integrate with Twilio consumptions API when programmatic sending of text messages is required. This integration entails acquiring Twilio hence the term 'Account SID' and 'Auth Token' referred to earlier the in context information mentioned as username which is typically, the a/c SID, Twilio phone number and authentication token.

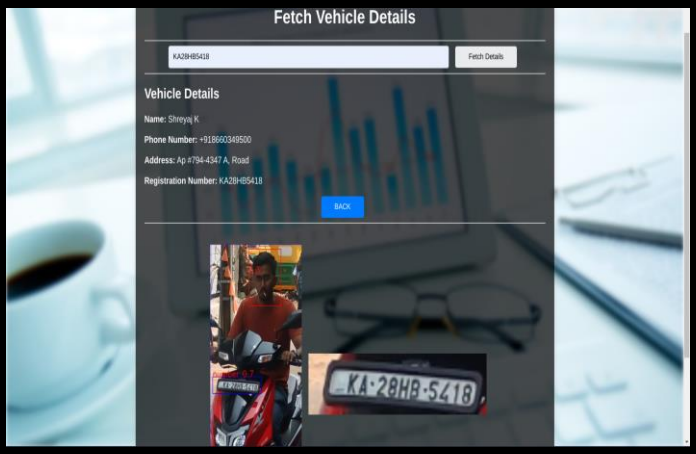

Fig 12: Generated Report

The detected images are stored in report file which contains image of the rider and dish number plate. In the case of the acronyms the user can enter the number and there after it displays the information of the rider.

VI. CONCLUSION:

This stable model provides a viable method to identify and mark those motorcycle riders who arent wearing helmets. The selection of the Transfer Learning technique in training the neural network and the integration of open-source libraries in the code as well as the use of sufficiently inexpensive equipment to apprehend staff members allows the incidence of a low-cost system. Based on the number of successfully detected items in our simulation, the application of the YOLO algorithm in our model shows promising results which makes it feasible to incorporate in real-life scenarios. The work can help create the basis for integrating this technology with fully self-sufficient line systems to provide its independent capabilities.

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