A SMART DEEP LEARNING BASED SELF DRIVING PRODUCT DELIVERY CAR IN PERSPECTIVE

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Abstract: The rapid expansion of a country’s economy is highly dependent on timely product distribution, which is hampered by terrible traffic congestion. Additional staff are also required to follow the delivery vehicle while it transports documents or records to another destination. This study proposes Delicar, a self-driving product delivery vehicle that can drive the vehicle on the road and report the current geographical location to the authority in real-time through a map. The equipped camera module captures the road image and transfers it to the computer via socket server programming. The raspberry pi sends the camera image and waits for the steering angle value. The image is fed to the pre-trained deep learning model that predicts the steering angle regarding that situation. Then the steering angle value is passed to the raspberry pi that directs the L298 motor driver which direction the wheel should follow. Based upon this direction, L298 decides either forward or left or right or backwards movement. The 3-cell 12V LiPo battery handles the power supply to the raspberry pi and L298 motor driver. A buck converter regulates a 5V 3A power supply to the raspberry pi to be working. Nvidia CNN architecture has been followed, containing nine layers including five convolution layers and three dense layers to develop the steering angle predictive model. Geoip2 (a python library) retrieves the longitude and latitude from the equipped system’s IP address to report the live geographical position to the authorities. After that, Folium is used to depict the geographical location. Moreover, the system’s infrastructure is far too low-cost and easy to install.

Keywords: computer vision; self-driving car; smart product delivery; Internet of Things; convolution neural network; Raspberry Pi 3.

Failure to deliver the product in time is a typical scenario of Bangladesh that affects the economy significantly. Among different reasons, the root cause of this scenario is to stay stuck in traffic congestion. According to a recent statistic, because of the congestion in Dhaka, the capital of Bangladesh, the amount of loss is around BDT 200 billion annually [1]. Investigators have reported a loss of 3.2 million working hours a day of traffic jams [2]. The Center for Economics and Business Research is projected that, by 2030, it will increase to almost BDT 300 billion [2]. Furthermore, in our country, road accidents are deeply linked with drivers’ behavior. Most of them are tempted to race on the lane, neglecting the risk of an accident. Disobeying traffic regulations and signals also leads to critical accidents and disasters. This ill-mindedness has caused so many disasters, taken too many souls and caused mass destruction in the last decades across the world. At least 4138 people were killed and 4411 wounded in 4147 crashes in 2019, while 2635 were killed and 1920 wounded in 2609 accidents in 2018, according to police [1]. In cases where it is impossible for a person to avoid a car accident, self-driving cars will save millions of lives and subside the on-time product delivery failure case without road accidents.

Artificial Intelligence (AI) plays a significant role in almost every aspect of human life, in every type of industry. For example, researchers [3,4] used a support vector regression algorithm to predict the water parameters. Considering physical and operational factors, another group of researchers engaged AI to assess pipe break rate and [6] decoding clinical biomarker space of COVID-19. Nowadays, AI is also broadly used in building the smart city , smart meter , agriculture , education , healthcare and so on. Machine learning is a branch of artificial intelligence that allows machines to learn without being explicitly taught from prior data or experiences. Nowadays, the neural network is a popular type of machine learning algorithm that mimics the human brain. CNN (Convolutional Neural Networks) and other groundbreaking systems have provided tremendous results in computer vision. In the majority of cases, they improved the preceding manual extraction features and created new cutting-edge solutions for such tasks as image classification , captioning , object detection or semantic segmentation . A machine’s reaction times and alerts

are far better. In addition, these vehicles were fitted with extraordinary capabilities by long-range cameras and ultrasonic sensors. Since the last decade, extensive work has been carried out on autonomous robotics and driving systems. Many research studies focus on the classification, identification and development of decisions based on the vision to improve, evolving techniques and algorithms. There are also some off-road studies. In our comprehensive study, we have felt the need for some missing features or works in those studied works.

Our self-driving product delivery vehicle can move on a road autonomously through the deployed deep learning pre-trained model. The car’s key input is real-time camera footage mounted on the roof. The system outputs the respective steering angle and drives the car accordingly. Because the camera is the only control system input, the purpose of the project is to teach the vehicle how to handle the steer. The network is trained on a different machine and then shifted to an onboard computer to regulate the vehicle. Then the autonomous product delivery vehicle is entirely independent of other machines. Furthermore, the position of the car is reported to the authority through a map to monitor. Obstacle avoidance is a different problem that can also be overcome, but it goes outside the scope of the study to combine it with the system. The current system configuration is not that capable of dealing with both steering angle prediction and obstacle avoidance. This self-driving vehicle work will significantly change traffic systems and public safety in a developing country like ours. It can also support national defense forces to perform ground monitoring or conduct rescue tasks. More particularly, the risk of an accident can be reduced dramatically.

Moreover, the development cost of this system requires about BDT 30K–40K for hardware and 20K–30K for software and other experimental purposes. As a result, product delivery car owners in developing nations like Bangladesh would find the technology beneficial and economical. The objectives of this research are to develop a self-driving car for overcoming the product delivery failure without any road accidents, to design a low-cost infrastructure with effective outcomes, to build an end-to-end deep learning model equipped in the selfdriving car prototype, and to

broadcast the geographical location of the vehicle through a map in real-time. With the introduction, this paper is composed of five parts. Section 2 covers the literature review, and Section 3 contains working procedure, functional units, dataset collection, normalization, augmentation, pre-processing, deep learning model and driving instruction forwarding strategies. Section 4 shows the experimental outcomes. Finally, Section 5 addresses the analysis and future scope.

Lots of significant works and research have been performed on the autonomous vehicle aspect. The NHTSA (National Highway and Traffic Safety Administration) describes five levels of autonomous vehicles shown in Figure 1. In no automation (level 0), the human driver does all the driving. Lane-keeping, cruise control or assisted breaking are a few examples of level 1(driver assistance). Tesla Autopilot claims at their level 2 position. The Waymo (Google) self-driving car is an example of conditional automation (level 3). Waymo announced in 2017 that they are testing level 4 driving. Full automation (level 5)—The driving system takes complete control over the entire driving task under all circumstances. The human driver does not need to be inside the car. Recent attacks targeting VANET (Vehicular ad hoc network) with autonomous Levels 1 to 4, which are not entirely autonomous, have been documented. Denial of service attack, sybil attack, timing attack, illusion attack ,message tampering, and node impersonation are examples of these types of attacks.

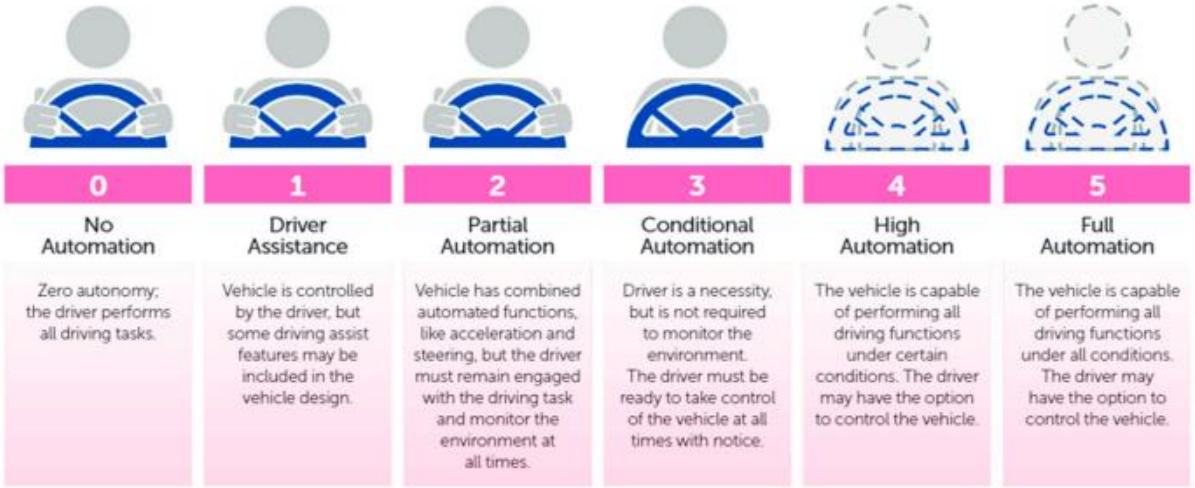

Figure 1. Levels of autonomous driving by NHTSA.

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