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Fastag Using Dedicated Short Range Communication

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Abstract: Congestion is a complex issue that frequently happens in major cities. Not only do arterial routes experience congestion, but so do toll roads. The current toll gate system mandates electronic payment transactions on toll highways. An RFID-based FASTag serves as the medium. Using this technology, the driver must stop at the automatic toll gate to tap the electronic toll card. However, the comparatively long reading time frequently causes more traffic congestion. This study aims to develop a DSRC-based system to lessen traffic congestion. We simulate the use of automatic toll gates using AnyLogic Software. Using this software, a few simulation situations were analyzed, which helped shorten the line at the toll booths.

Index Terms **– DSRC, Anylogic, RFID, FASTag**

INTRODUCTION

For Indian drivers, excessive traffic is a regular occurrence, thus having to wait in long lines at toll booths is always a hassle and a waste of time. The government has implemented FASTag, an RFID-powered tag, to address this issue and make the toll

The experience of the plaza is less complicated. You have to drive through the toll booth, attach the tag to your windscreen, and you're done! The plaza's scanner will recognize the tag, which will automatically deduct the toll fee from your bank account. Having said that, the system is still quite young and therefore susceptible to some mistakes and failures. The card might be easily lost, damaged, or stolen because it is attached to your windscreen.

I. FASTAG

Rapid and exciting changes are being made to the Indian economy's face. As a result of the digital transition, our lives are now more convenient and effective, and routine tasks are no longer taxing. Attempt to recall the last time you had to endure hours-long lines. Or when you needed to visit several different stores to acquire a small number of items? As a result, daily tasks are now simple, quick, and convenient thanks to widespread digitization across many industries. And now it is being applied on the highways, away from your house. Around 615 toll plazas on national highways across the nation have installed the FASTag technology adjustments. The administration is anxious to adopt a cashless system.

1.1. Introduction to RFID

An electronic tag or radio frequency identification (RFID) technology is a communication tool that uses radio waves to recognize particular targets and read and write data about them. Furthermore, it is not necessary to determine if the optical or mechanical contact between the system and the designated target Fast reading and writing, non-visual identification, mobile recognition, multi-target recognition, locating, and long-term tracking management are all capabilities of the system. The recognition process is unaffected by an unfavorable environment and can read information quickly, safely, and reliably. As a result, a variety of applications are possible for RFID technology.

An automatic identifying technology without interaction is radio frequency identification. It may utilize the radio frequency signal to automatically identify the target object and get the necessary information.

1.2. DSRC

The 802.11p-based wireless communication technology known as dedicated short-range communication (DSRC) offers highly secure, quick direct communication between cars and the surrounding infrastructure. The IEEE 802.11p standard is an addition to IEEE 802.11 that specifies improvements to support applications for Intelligent Transportation Systems (ITS). The Internet of Things seeks to transform the interconnectivity of all our devices, and increasingly this includes our vehicles too. Connected vehicles are becoming more and more commonplace and soon every new car will be able to 'talk' to the others on the road, as well as devices on the roadside. Mobility and safety information is shared on this network to reduce collisions and communicate with stoplights and other such infrastructure. Everything can become connected, which is exactly what V2X stands for: vehicle-to-everything. This bi-directional communication is possible through the wireless technology DSRC, which we at GTT Wireless are pleased to support with our range of antenna.

DSRC (Dedicated Short-Range Communications) uses WAVE, a wireless standard that uses the 5.9GHz band for direct communication. What makes it perfect for the job is that it means vehicles don't have to rely on any other infrastructure, such as cellular, and its short-to-medium range channels are designed for automotive use, transmitting information either one-way or two-way depending on the application. DSRC is used for communication between vehicles (V2V) and between a vehicle and surrounding traffic infrastructure (V2I), both of which fit into the all-encompassing term V2X.

Each vehicle using DSRC transmits its precise location, speed, and direction 10 times per second to every vehicle in the surrounding area. When received, this data is used by the nearby vehicles to estimate any potential risk based on the constantly updating stream of data. These traded messages are deciphered into multiple, actionable applications, which are each defined using a handy initialism. These include, but are not limited to, Intersection Movement Assistance (IMA), Left Turn Assistance (LTA), Cooperative Awareness Messages (CAM), Decentralized Environmental Notification Messages (DENM), and Basic Safety Message (BSM).

Despite the SR of DSRC standing for 'Short-Range', its communication range is upwards of 1km. It's purposefully designed for vehicular applications and can therefore work effectively at speeds as high as 500 km/h. But what makes DSRC truly special is its ability to circumvent obstructions. Uniquely, they don't impede the sensor or its efficacy because 'Non-Line-of-Sight' grants the ability to, essentially, see around corners. It even easily operates in extreme weather conditions. DSRC may use a Wi-Fi wireless standard but it was designed with cybersecurity in mind. The system uses digital signatures to communicate, ensuring trust and security between devices. Any vehicle receiving data checks the authenticity of the message and deduces whether it is from a valid source. Privacy is paramount in the digital age and each message is anonymous, maintaining the privacy of the driver and not exposing the identity of other vehicles. WLAN is appropriate for the task because of its low latency, measured in mere milliseconds.

2. ANYLOGIC

The AnyLogic Company created the multi-method simulation modelling tool known as AnyLogic (former XJ Technologies). It supports system dynamics, discrete events, and agent-based simulation techniques. AnyLogic is a simulation program that runs on multiple platforms. Linux, macOS, and Windows. Markets and competition, healthcare, manufacturing, supply chains and logistics, retail, business processes, social and ecosystem dynamics, military, project and asset management, pedestrian dynamics and traffic, IT, and aerospace are just a few of the industries that AnyLogic is used to model. Over 40% of Fortune 100 businesses currently use AnyLogic Simulation Software, the industry-leading simulation tool for commercial and industrial applications. Using AnyLogic simulation models, managers, engineers, and analysts can learn more. Across various industrial sectors, including logistics, manufacturing, transportation, aerospace, defense, and mining, optimize complex systems and processes.

3. METHODOLOGY

DSRC is the most common form of primary electronic congestion-pricing technology in general use and is standard on most free-flow toll facilities. The technology is based on onboard units (OBUs), sometimes referred to as tags or transponders, which communicate with gantry-mounted equipment at checkpoints. The roadside equipment identifies and verifies each vehicle's OBU, and depending on the type of system, either processes a charge from its designated account or confirms its rights of access. In most multi-lane free-flow systems, the DSRC system also acts to locate the vehicle within its detection zone by using an array of DSRC transceivers. Combinations of toll points can be used to facilitate distance-based charging systems, with special charging conditions for particular entry and exit points or times. The enforcement of this type of scheme is generally addressed by using roadside enforcement cameras and ALPR technology. There is a range of DSRC systems in use and under development. Some use infrared communications; this technology has not been deployed widely in higher-speed applications and is not generally considered an open standard. Most are based on microwave communication.

The most common systems currently in use are based on a 5.8-GHz frequency, using the European CEN-278

standard. This standard is now well-developed and delivers robust and secure OBU devices with an average battery life of around 5 years. The next generation of 5.9-GHz systems, which are being developed mainly in the United States to address a wider spectrum of intelligent transportation systems (ITS) applications, will provide longer-range communication and multiple channels. Although not currently in use on 14 any operational pricing systems, these OBUs are planned to become standard installations in all new vehicles within the next decade. DSRC systems can be expanded relatively easily onto other routes or across adjacent areas through the deployment of additional tolls or checkpoints. However, expanding these types of systems to cover much wider areas is less cost-effective, because the number of toll points to provide effective coverage can increase significantly. In multi-lane situations, an array of transceivers and classifiers will be required, generally mounted on purpose-built gantries or potentially mounted on existing structures. Where multi-lane facilities are to be installed in two directions, the relative location of gantries also requires consideration, because a degree of separation is required between some equipment.

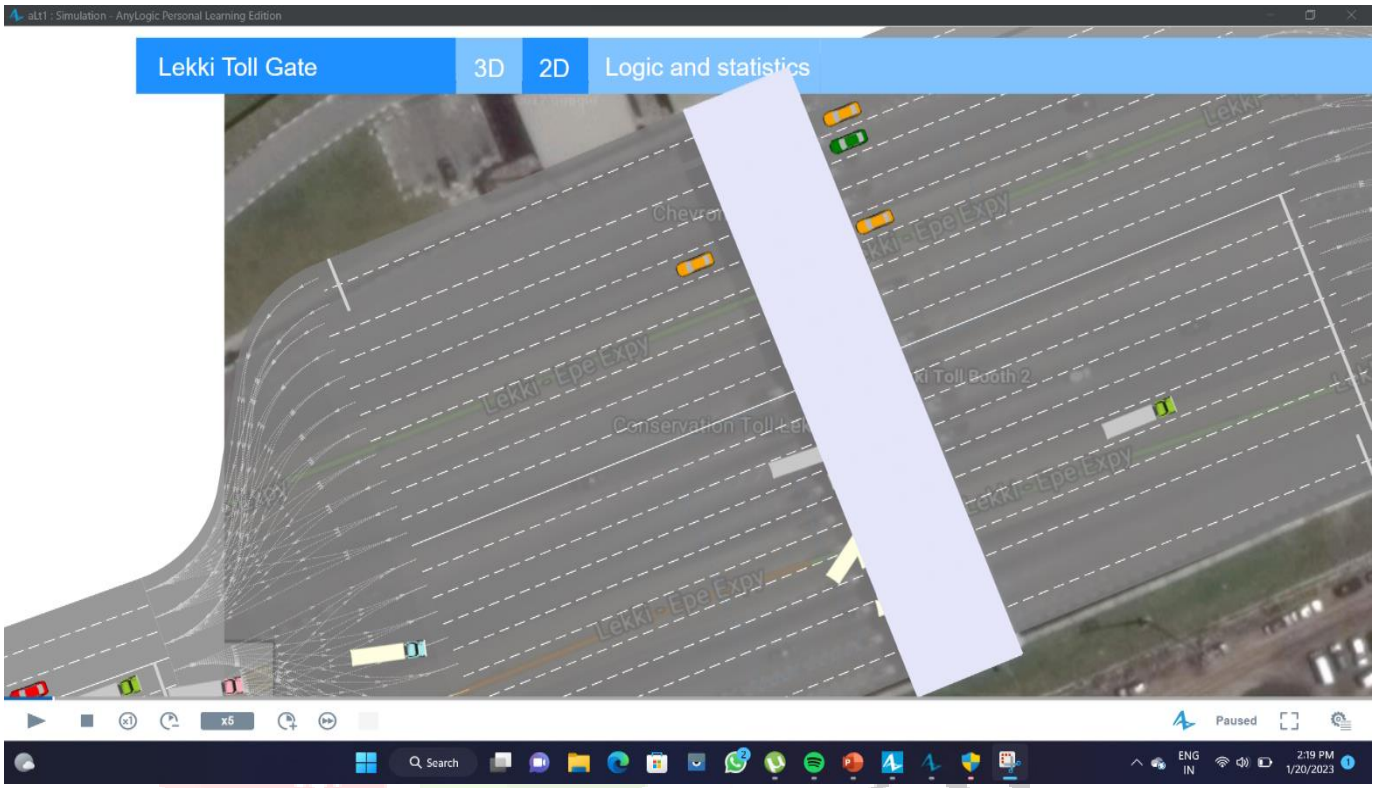

Fig: Simulation part in 2D

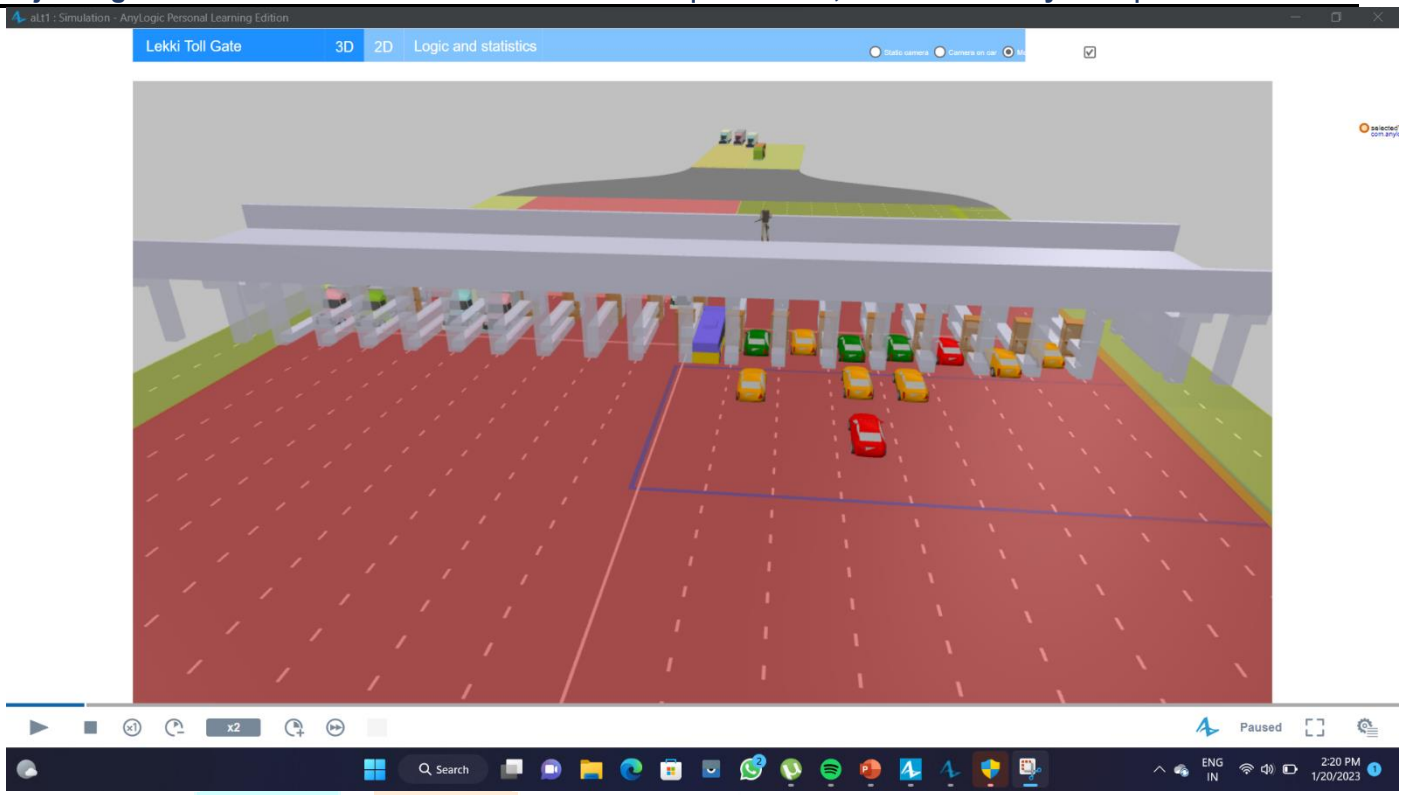

Fig: Simulation part in 3D

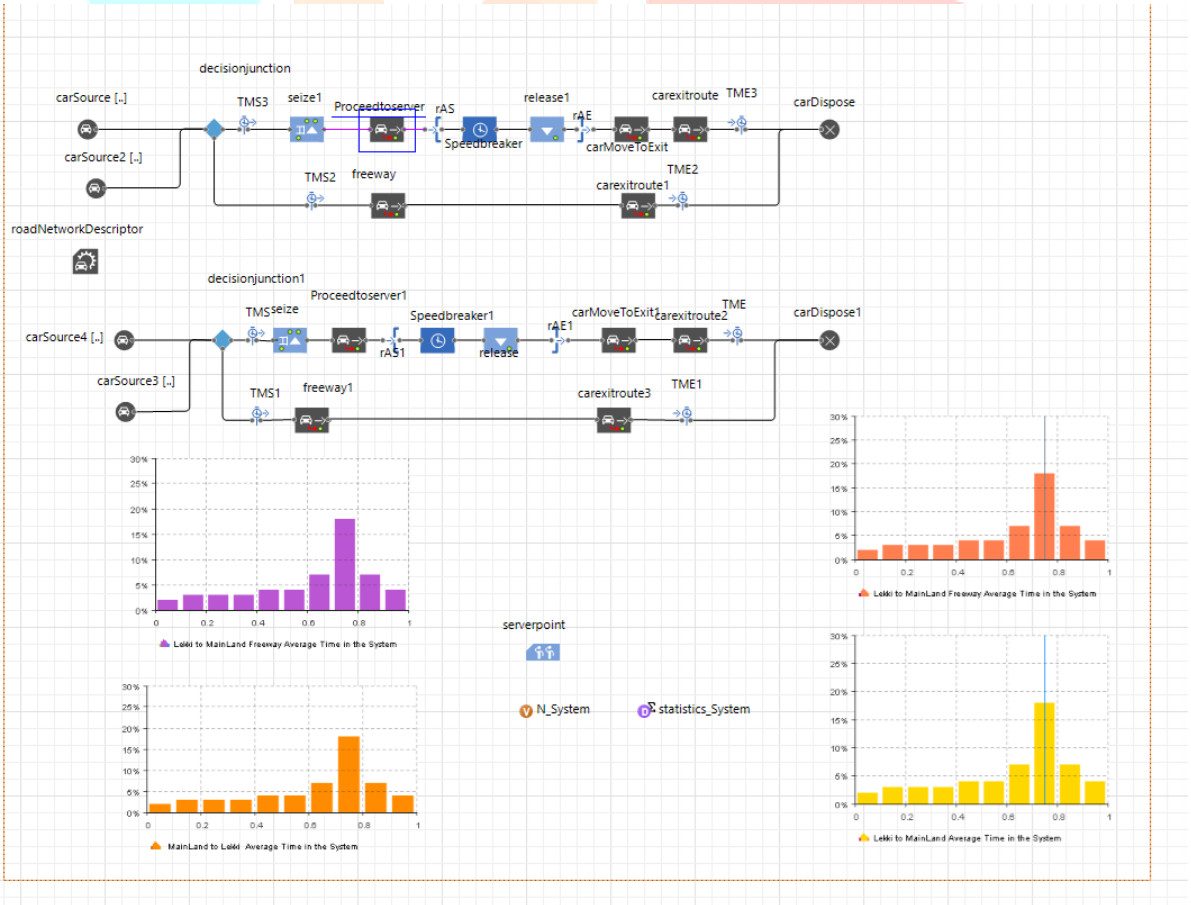

Fig: Process and Statistics

4. FLOW GRAPH

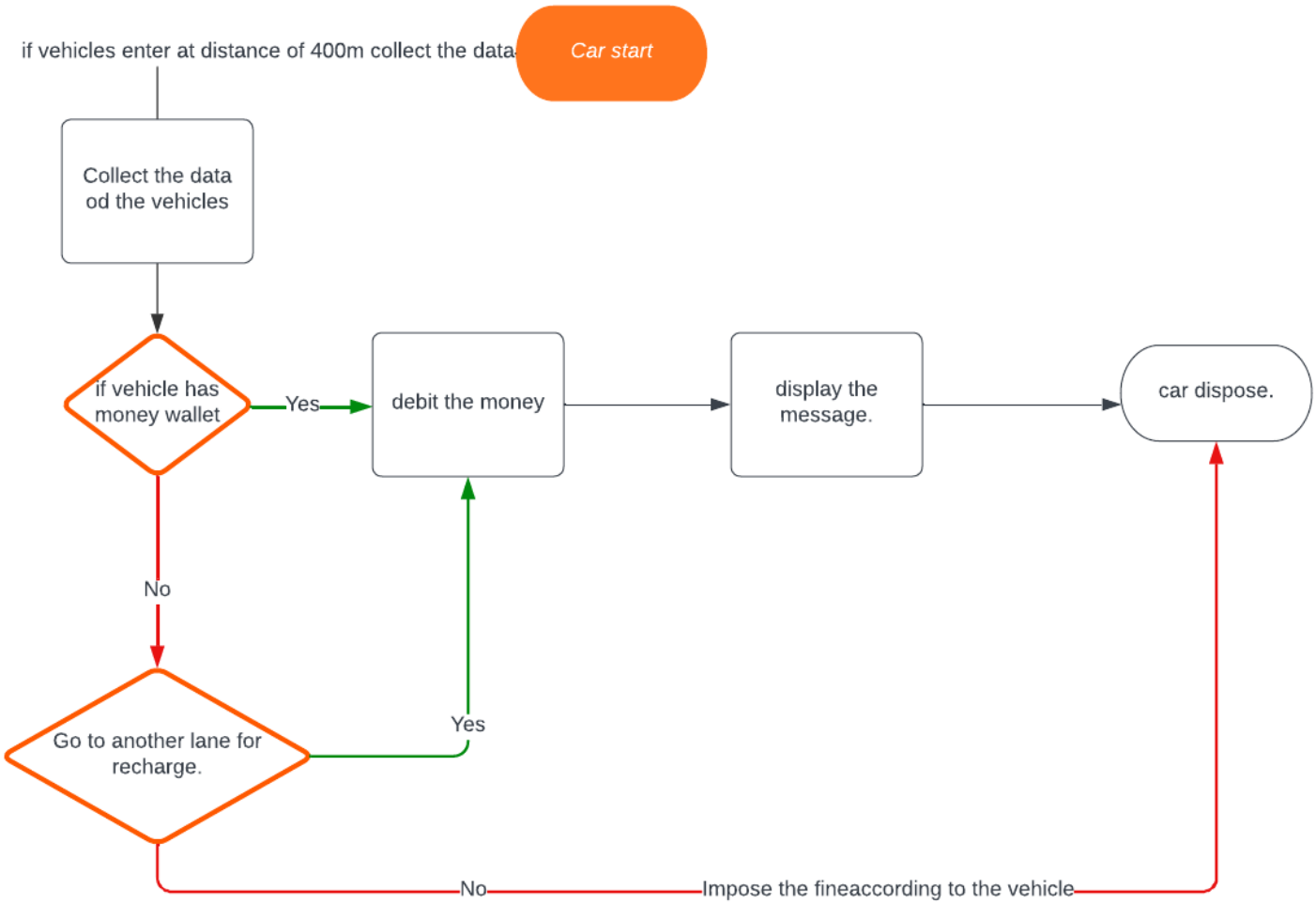

Fig 4.1: *Flow Graph*

5. RESULTS

From the simulation of the Anylogic we have obtained the Mean speed and Deviation speed of vehicles. Then we observed that the time delay of vehicles is less in DSRC technology when compared to RFID.

Mean(ns)	Deviation(ns)	minimum	maximum	Mean confidence	number
0.953798	0.20992215	0	1	0.12634159	110
0.951799	0.21419001	0	1	0.129061503	108
28.1615	2.4836172	1	33	1.491384679	327
2.383335	0.5150762	0.95105028	3.42545676	0.142856435	52
0.543062	0.07128904	0.48845016	0.80212122	0.031309682	22
0.51868	0.07527135	0.46070108	0.74088857	0.032332034	23
2.29883	0.54753953	0.95333586	4.08791981	0.151860143	52

Table 5.1: *Descriptive Statistics*

6. CONCLUSION

There by finally the conclusion is when compared to RFID based FASTag ,DSRC based FASTag results in avoidance of congestion at toll gates. The waiting time of vehicles at toll boots is less when DSRC based FASTag is used. From the graphs, average speed of the vehicles, average time of the vehicles ,mean of the vehicles , median of the vehicles is obtained. From average time of the vehicles, there by concluding that DSRC technology will be more useful in tollgate congestion rather than RFID tollgate system . By installing additional tolls or checkpoints, DSRC systems can be readily extended to other routes or across neighboring regions. As a result of the potentially large number of toll sites required to offer adequate coverage, expanding these kinds of systems to cover far greater areas is less cost-effective.

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