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Pusat Asasi

Tackling Smart City Traffic Congestion

Alvi Khan Chowdhury, Louis Gautama Lie, Yanuar Wiriyanadi Halim, Adrian Corson Mulia, Emerson Brilliant Chow, *Noor Idayu Mohd Tahir

Department of Mechanical and Mechatronic Engineering, UCSI University, Kuala Lumpur, Malaysia

*E-mail: nooridayu@ucsiuniversity.edu.my

ABSTRACT

One of the key issues noticed in traffic light points is that many vehicles queue and wait for a long time to cross the traffic light signal even if there is no pedestrian to cross the zebra cross. This time-consuming ineffective traffic control system, as a result, increases the growth of energy loss and harmful gas loss to the environment. In this study, a smart automated traffic control system later named OptiTraffic was developed to capture real-time data and make judgments automatically in order to efficiently and effectively handle the traffic control system. The basic goal of this technology is to automatically detect pedestrians and enable them to cross the road. As a result, reducing the line of vehicles at the traffic light because the traffic signal would not be halted for oncoming vehicles until there are genuine people waiting to cross the road. The smart system utilized deep learning, Raspberry Pi microcontroller, pressure sensors and cameras to collect real-time data and make choices on the pedestrian traffic light management system. The system has cameras along with pressure sensors to validate the pedestrians waiting at the side of the road to cross the road. In this study, the YOLOV5s deep learning model was trained and integrated with the microcontroller to detect pedestrians using the camera. The timer shall turn on for a short period of time when pedestrians get detected at the side of the road. When the stated time of the timer turns on, the system shall turn on the green light for pedestrians in order to allow the pedestrian to cross the road. The input from both the camera and the pressure sensor would act as a confirmation that the pedestrian is certainly willing to cross the road. The final prototype outcome is a complete success as per the previous expectations from the researchers as the real-time detection accuracy of pedestrians was around 88% and also the system was working smoothly overall. The system would overcome the current issues faced by people at the traffic signal points. Lastly, the report concluded with recommendations for further improvements to the developed system.

Keywords: Internet of things; Computer Vision; Optimised Traffic Control System

INTRODUCTION

Problem Statement:

One of the most pressing concerns confronting modern society is traffic congestion. Traffic flow optimization is critical for Sustainable Cities and Communities in order to reduce energy and economic waste. One of the issues observed at traffic light points is that many vehicles queue and wait for an extended period of time even when there are no more pedestrians to cross the zebra cross. This may appear to be a small concern now, but in the long run, vehicles queuing even when there are no more pedestrians to cross the zebra crossing would be a major concern because it would waste energy owing to the inefficiency of the current traffic signal control system.

Project Objectives:

- To develop a smart automated pedestrian traffic control system using deep learning, microcontrollers, cameras and lastly various sensors.
- To ensure the safety of pedestrians while crossing the road utilizing the automated traffic control system.
- To ensure real-time data collection from the traffic signals and make decisions based on it.
- To ensure the security of the automated pedestrian traffic control system from theft.
- To make the system self-sufficient, sustainable and cost-effective.

Innovation Motivation:

With more people moving to cities, there is a growing need for innovative transportation solutions that can accommodate the increasing volume of pedestrian traffic. The OptiTraffic pedestrian traffic control system can help optimize pedestrian flow and reduce congestion in urban areas, making it easier for people to get around and reducing the environmental impact of transportation.

INNOVATION DEVELOPMENT

OptiTraffic is a smart system that shall use deep learning, microcontrollers, pressure sensor and cameras to control the flow of the traffic light. To activate the system traffic light, the pedestrian must step on the pressure sensor and get detected by the camera. After giving the red signal to the vehicles and giving the green signal to the pedestrians, the pedestrians could cross the road easily. The system is equipped with an internal timer. During the green signal of the pedestrian traffic light, if there are more pedestrians trying to cross the road and they step on the pressure sensor, it will refresh the internal timer. If no pedestrians step on the pressure sensor for a designated time of the internal timer, the system will decide that there are no more pedestrians trying to cross the road and will immediately send the red signal to the pedestrians, giving the green signal back to the vehicle's traffic light. In this way, this mechanism will reduce pointless waiting time for vehicles and tackle traffic congestion.

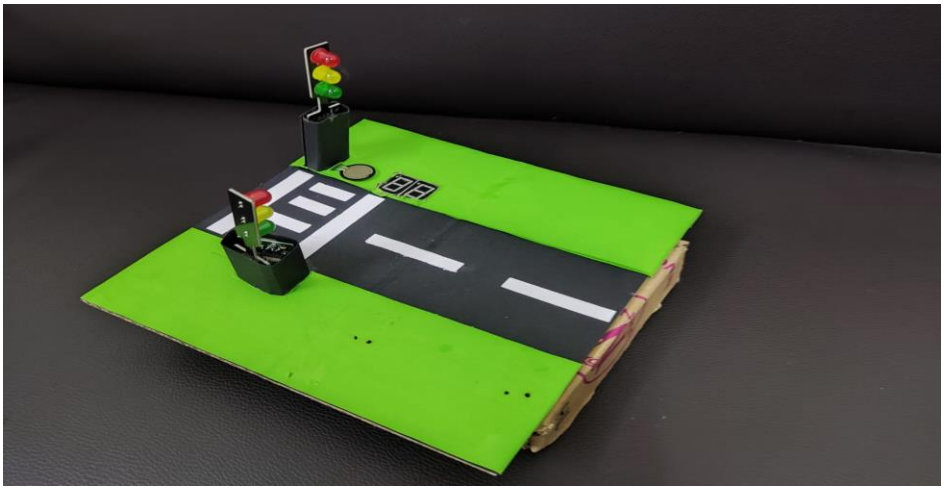

Figure 1: Final Prototype Image

LITERATURE REVIEW

Deep learning has been used by researchers to help manifest smart traffic. Deep learning opens up various methods of detection for researchers. One of the methods of detecting pedestrians and vehicles was to calculate the convex hull of each element and check and compare each pixel with its corresponding pixel. Each element is extracted as separate images. Finally, the Kalman filter is used to track and predict the movement of vehicles and pedestrians [1].

There is also a method where data from vehicles equipped with IoV (Internet of Vehicles) are assembled and analysed by deep learning techniques to predict and control traffic congestion [2]. By deploying the sensors at crucial junctions, the data could be streamed and traffic congestion could be predicted [3]. Another method of detection uses a predefined line to count the number of vehicles passing through each side of the road and control the duration of the traffic light based on the traffic load [4]. By using the YOLO algorithm, the detection system could also help to distinguish between normal vehicles and emergency vehicles such as ambulance cars and police cars [5]. The number of vehicles counted could also be used to predict the flow of the traffic for each intersection using deep learning. The traffic flow of the next period could also be predicted using past predictions as parameters [6].

Deep learning could also be used to detect traffic congestion by inputting parameters such as time, speed, temperature, wind, and weather to the neural network that was trained and predict the point of congestion. When the congestion point is found, the vehicles would then receive a message regarding the congestion point and recommend an alternate route [7].

The presence of pedestrians can be detected using weight measurements from pressure-sensitive curbside pads. They are less affected by the weather and other environmental factors compared to other kinds of sensors. Following the detection of the pedestrian, the presence of the pedestrian signal is a good solution for safety for warning the driver to slow down speed [8].

COMMERCIAL POTENTIAL

The invention of a traffic control system that optimizes pedestrian flow and reduces waiting times for vehicles has great relevance in addressing the problem of traffic congestion. As stated in the problem statement, traffic congestion is one of the most pressing concerns confronting modern society, and it has serious implications for energy consumption and economic waste. A more efficient traffic control system can help reduce congestion and improve the sustainability of cities and communities.

The problem statement also highlights the inefficiencies of the current traffic signal control system, which results in vehicles queuing even when there are no more pedestrians to cross the zebra crossing. This inefficiency can lead to unnecessary energy consumption and economic waste, and it can also contribute to frustration and inconvenience for drivers.

The invention of the OptiTraffic traffic control system optimizes pedestrian flow and reduces waiting times for vehicles can address these issues by improving the efficiency of traffic signal control. By using advanced technologies such as sensors, computer vision, and embedded systems, the system can detect and respond to changes in pedestrian traffic in real-time, allowing for more precise and efficient control of traffic signals. This can help reduce waiting times for vehicles and improve the overall flow of traffic, reducing energy consumption and

economic waste in the process.

The market needs and potential for the OptiTraffic traffic control system that optimizes pedestrian flow and reduces waiting times for vehicles are significant. The pedestrian traffic control system can provide economic benefits by improving mobility and reducing congestion, which can boost productivity and create cost savings for transportation providers and other businesses. It can also help reduce the cost of fuel and energy consumption, leading to economic benefits for the community as a whole. Reducing congestion and improving traffic flow can help reduce the environmental impact of transportation. The pedestrian traffic control system can help reduce greenhouse gas emissions by reducing idle times for vehicles and improving fuel efficiency.

Overall, the market potential for the OptiTraffic traffic control system that optimizes pedestrian flow and reduces waiting times for vehicles is significant. As cities and communities continue to grow and evolve, the demand for more efficient and sustainable transportation solutions will only increase, making this an exciting area for innovation and investment.

The innovation of the OptiTraffic smart pedestrian traffic control system provides an effective solution to the needs of pedestrians by reducing waiting times and increasing the overall efficiency of pedestrian flow. By incorporating advanced technologies such as sensors, computer vision, and embedded systems, the system can detect and respond to changes in pedestrian traffic in real-time, allowing for more precise and efficient control of traffic signals. The system can help reduce waiting times for pedestrians at crosswalks and intersections, making it easier and faster for them to get where they need to go. By optimizing pedestrian flow, the system can help reduce congestion and improve the overall flow of traffic, making it easier for pedestrians to navigate busy areas. By reducing congestion and improving traffic flow, the system can help reduce the environmental impact of transportation and contribute to a more sustainable future.

CONCLUSION

Overall, the developers implemented the smart traffic control system successfully. However, after developing the prototype, the developers realised that there are certain works which can be implemented in the future for better implementation of the prototype in real-life situations. Firstly, the microcontroller controlling the system shall be improvised in order to reduce the lag of data transfer between the system prototype and the data analysis dashboard of the system. Furthermore, in order to protect the camera from weather changes when applied in real-life conditions in the future, the developers decided to equip the camera with a case sealed with waterproof rubbers and fill the internals of the camera with silica gels. For the power supply, it is recommendable to increase the power by adding more batteries, especially using a lot of output devices. Moreover, in order to protect the pressure sensor from damage as it is required for the pressure sensor to be stepped on by potential pedestrians, the developers decided to install pressure snubbers or dampers between the process and the pressure instrument connection with different grades of porosity selection for protection of the pressure sensor.

As smart traffic control systems continue to evolve, there is a need for ongoing research and development. To guide future efforts in this area, the smart traffic control system developers proposed the following recommendations for potential researchers.

Pedestrian safety is an important concern on roads and highways, and there are several safety features in place to help protect pedestrians. One key safety feature is the Pedestrian crossing the road warning sign for the driver. This sign is a highly recognizable and standardized symbol that alerts drivers to the presence of pedestrians and to the possibility of a pedestrian crossing the road ahead. The sign is typically placed at locations where there are designated pedestrian crossings areas, such as crosswalks or intersections. It is designed to be highly visible and easily understood, with a simple graphic of a person walking and an arrow indicating the direction of travel.

The suggestion to add small LED or flashing lights in the ground beside traffic is aimed at improving pedestrian safety, particularly in situations where people may be distracted by their phones and unaware of their surroundings. The idea is to install these lights in strategic locations, such as at crosswalks or intersections, to create a visual cue for pedestrians to be more aware of their surroundings and potential hazards, such as oncoming traffic. The lights could be embedded into the pavement or ground and could be programmed to turn on automatically during certain times of the day or when a pedestrian is detected. The use of these lights could help to reduce the risk of accidents caused by distracted pedestrians who are not paying attention to traffic. By drawing their attention to potential hazards, the lights could encourage pedestrians to be more cautious and aware of their surroundings, reducing the likelihood of accidents or near-misses. Overall, adding small LED or flashing lights in the ground beside traffic is a creative and innovative solution to an increasingly common problem. By leveraging technology in this way, a safer and more secure environment for pedestrians would be created, while also promoting greater awareness and attentiveness on the part of both pedestrians and drivers.

The suggestion to implement automatic barriers at pedestrian crossings is aimed at improving pedestrian safety by preventing drivers, particularly motorcyclists, from running through red lights and endangering pedestrians. At present, some drivers, particularly those riding motorcycles, may ignore traffic lights and continue through red lights, even if pedestrians are present. This poses a serious risk to pedestrians, who may be hit by vehicles as they cross the road. Automatic barriers would work by blocking the road when the pedestrian crossing signal is activated, preventing any vehicles from passing through until the signal changes to allow traffic to proceed. The barriers could be operated automatically, based on sensors or timers that detect when the pedestrian crossing signal is activated. By implementing automatic barriers, a safer environment for pedestrians could be created by preventing drivers from running through red lights and endangering those on foot. This would also help to promote greater respect for traffic laws and regulations and encourage all road users to be more mindful of the safety of others. Overall, automatic barriers at pedestrian crossings represent a promising solution to a serious safety concern. By preventing reckless drivers from endangering pedestrians, a safer and more secure environment for everyone on the road could be created.

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