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COS7039-B SEM 1 Internet of Things (IoT)

IoT in Traffic Light Control System

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# Introduction

Traffic control has always been one of the basic features of an emerging city and important in road guidance across the city. As a city grows, it becomes more prone to high traffic circumstances due to high number of people moving around living their daily lives. Traffic controls today are only used by motorist but also cyclists and pedestrian’s movements as road usage must be efficiently controlled.

Traffic continues to evolve as there is an increased need to move people and goods from one location to another. Traffic flows differ fundamentally across locations and at different times of the day. This flow is determined by human behaviour and this data is important to program this traffic controls to be more efficient in navigating vehicles across these routes.

In the UK, the future of motoring is set to be electric as the country has set to transition to electric vehicles by 2030 outlined by British Prime Minister Boris Johnson in his “Ten-point” climate plan dubbed the “Green Industrial Revolution” which is worth £12 billion (Campbell 2021). This means road transportation is gradually going to be more electrical with no petrol or diesel car on sale by 2030.

In May of 2021, UK’s first driverless bus takes to the streets in a new trial in Cambridge (Ruff 2021). We are gradually entering into an era where transportation is automated and there is need for infrastructure readiness such as traffic control data being made available to this self-driving vehicles. This research would be focused on building a traffic light system and sending out the traffic light timings through an MQTT Protocol, where these self-driven cars can subscribe and have access to this traffic controls as they navigate passengers across the city. A publisher and subscriber system would be built around the traffic control system. The car interfaces can subscribe to this channel and be able to tell when the lights change.

As humans, we strive for comfort and the use of autonomous systems to aide or assist us in our daily activities. Traffic in every major city has always been a continuous problem with little improvements. For smart cities to be successful, data needs to be generated, analysed, and processed for future design making to improve how this infrastructures work. This means infrastructure needs to be ready before 2030 to realize the dream of full automated cities with its citizens transported around using self-driven vehicles such as trains, buses, and taxi cars. The city infrastructure would act as a digital traffic warden allowing these vehicles know when to go or stop at traffic light junctions. While this system can be enhanced beyond this, the focus of this research is first on making the traditional traffic light system available to digital systems.

In this system we would demonstrate a traffic light system which is programmed and controlled using a python program running on a raspberry pi kit with LED light sensors connected to it via a bread board. These LED lights would represent the traffic lights at such junctions. The python program would be responsible for controlling the lights using a time-based decision and then sending the traffic time data via a publisher using MQTT which electric vehicles can subscribe and get access to this data. This is expected that the city would also provide internet infrastructures for these cars to utilize this system. Users can there for focus on enjoying other activities while being accurately driven to their various destinations.

# Aims and Objectives.

* Aim of this project is to make the current traditional traffic system available to IoT devices.
* Provide an MQTT subscription channel for companies developing systems that leverage on traffic control and IoT such as electric vehicles which would rely on these to provide self-driving and traffic navigation features.
* I will create a mini “Traffic light control” system to demonstrate the current traditional system.
* Show a roadmap of how IoT can take the current traffic control system and make it ready for a smart city.

# Literature Review

This chapter gives a brief information on today’s traditional traffic control system, smart cities and the use of IoT in traffic controls as well as related information to the proposed system.

## Traditional Traffic Light Control System

Traffic light signals, also known as stoplights are signalling devices positioned at road intersections, pedestrian crossings and other locations to control the flow of traffic (McShane 1999).

Traffic lights were internationally standardized by the Vienna Convention on Road Signs and Signals (Tryjanowski et al. 2021). According to Tryjanowski, the traffic lights alternate the right of way to road users using illuminating lamps of three standard colours:

* Red light – Stops all traffic from proceeding. A red light indicates all traffic movements should stop and usually safe for pedestrians to cross.
* Amber light (also known as Orange light) – It is a warning light that tells the users that the signal is about to change to either red (stop) or green (go).
* Green light – This tells users that traffic movements are allowed and it is safe to move. (Test 2019)

## Smart Cities

A smart city could be defined as “The use of Smart Computing technologies to make the critical infrastructure components and services of a city which includes city administration, education, healthcare, public safety, real estate, transportation and utilities more intelligent, interconnected and efficient” (Washburn et al. 2009)

## Internet of Things (IoT)

There is no textbook or distinct definition for Internet of Things, but IoT is coined from two words, “Internet” and “Things”. The internet is a global system of interconnected computer networks that uses the standard Internet Protocol suite (TCP/IP) to serve billions of users world worldwide. It is a network of networks that consists of millions of private, public, academic, business and government networks, of a local to global scope, that are linked by a broad array of electronic, wireless and optical networking technologies (Nunberg 2012). Things here are the objects we have in the physical or material world (Castaño Díaz 2013). IoT connects these two worlds together by making them able to interact and part of the global or local network.

# Requirements

# Methodology

## Hardware Implementation

## Software Implementation

# Observations and Results

# Conclusion

# Appendix

All source codes and report can be found on GitHub via the repository

<https://github.com/eniga/mqtt_trafficlight>

# References:

Campbell, M. (2021) *UK has no 'roadmap' towards electric car usage by 2030.* Euronews: Euronews [*https://www.euronews.com/green/2021/02/12/uk-has-no-roadmap-towards-electric-car-usage-by-2030*](https://www.euronews.com/green/2021/02/12/uk-has-no-roadmap-towards-electric-car-usage-by-2030)

Castaño Díaz, C. M. (2013) Defining and characterizing the concept of Internet Meme. *Ces Psicología* 6 (2), 82-104.

McShane, C. (1999) The origins and globalization of traffic control signals. *Journal of Urban History* 25 (3), 379-404.

Nunberg, G. (2012) *The Advent of the Internet*. Open Journal of Applied Sciences.

Ruff, M. (2021) *UK’s first self-driving bus takes to Cambridge roads.* Garagewire. [*https://garagewire.co.uk/news/videos/uks-first-self-driving-bus-takes-to-cambridge-roads/*](https://garagewire.co.uk/news/videos/uks-first-self-driving-bus-takes-to-cambridge-roads/) Accessed June 1, 2021.

Test, T. (2019) *Traffic Lights in the UK - Meanings,Sequence & Rules for Learner Drivers.* Theory Test. [*https://theorytest.org.uk/traffic-lights/*](https://theorytest.org.uk/traffic-lights/)

Tryjanowski, P., Beim, M., Kubicka, A. M., Morelli, F., Sparks, T. H. and Sklenicka, P. (2021) On the origin of species on road warning signs. *Global Ecology and Conservation*, e01600.

Washburn, D., Sindhu, U., Balaouras, S., Dines, R. A., Hayes, N. and Nelson, L. E. (2009) Helping CIOs understand “smart city” initiatives. *Growth* 17 (2), 1-17.