Smart Systems and Services for Vulnerable Road Users

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Introduction

Vulnerable Road Users (VRU) are defined in the ITS Directive EU *Directive for Intelligent Transport* Systems as non- motorised road users, such as pedestrians and cyclists as well as motorcyclists and persons with disabilities or reduced mobility and orientation. The adoption of 'Smart' technologies and connected data can enable traffic authorities and transport operators to build more sustainable, safer, and more reliable transport networks that enhance mobility, safety and comfort for VRUs, including reduction in casualty and fatality rates, whilst also contributing to physical and mental health benefits and carbon reduction initiatives through promotion of active travel. However, a great number of VRU-friendly road user systems have been largely limited to in-vehicle information systems targeted at drivers, leaving VRUs as passive beneficiaries, and side-lining authorities whilst also remaining relatively expensive and impractical to implement and maintain. This case study aims to create new knowledge targeted specifically at local authorities to identify next generation VRU-friendly information systems and services that can enhance mobility and safety and contribute to local policy objectives such as active travel and reducing car-based journeys. This study supports, and was part funded by, the Manual for Smart Streets Project.

Context

According to the World Health Organization (WHO), since 2007 approximately 1.25 million people have died each year in traffic accidents worldwide. Half of these deaths are pedestrians, cyclists or motorcyclists, commonly known as Vulnerable Road Users (VRU) (Khayesi, 2020). VRUs are defined in the ITS Directive as "non-motorised road users, such as pedestrians and cyclists as well as motor-cyclists and persons with disabilities or reduced mobility and orientation". More generally, this definition can be broadened to include children, inexperienced drivers, and horse riders.

In practice, this is a very diverse, heterogenous group. In particular, the needs of persons with reduced mobility (PRM) are more varied and complex than those of able-bodied pedestrians and cyclists, with independent mobility at their heart as well as safety; however, disability is also a very personal concept, so the needs of an individual must be taken into consideration.

A range of basic technologies can be used to help enhance the safety of VRUs from drivers. These are:

- Cameras – to assist vehicular movement through enhanced visibility and blind spot reduction
- Sensors – to assist vehicular movement through enhanced visibility and blind spot reduction
- Alarms – to alert VRU to a potential hazard
- Visual aids – to alert VRU to a potential hazard

These technologies form the core components of many Intelligent Transport Systems (ITS) which can be connected, cooperative or bespoke. ITS contribute towards making streets – including users, vehicles and infrastructure – smarter. However, despite substantial progress in improving road safety over the last decade, VRUs have not profited as much as vehicle occupants from these developments.

This case study focuses on a review of existing and emerging VRU-friendly ITS with particular emphasis on information systems and services, and their likely future trajectory of innovation over the next five years. The chief beneficiary is intended to be local authorities who must balance a range of different policy objectives including safety, security, accessibility, economic growth, environmental sustainability, and resilience of infrastructure.

This case study features overviews of selected technologies that are available or near to market. It links them to different policy outcomes (for example active mobility schemes), identifies specific data requirements and summarises the pros and cons of innovations. This case study is a useful resource for local authorities to inform their transport strategies and guide them in future implementation of technologies to support VRUs.

Cooperative Intelligent Transport Systems (C-ITS)

C-ITS is a technology platform for communication between vehicles or infrastructure (V2I or I2V) or between vehicles and anything (V2X). The technology was originally developed for WLAN architecture to supply Dedicate Short-Range Communication (DSRC) but now incorporates use of cellular networks. WLAN is useful for V2X by providing low latency and network independence capabilities. Cellular V2X (cV2X) supports communication over cellular networks, and directly via device-to- device (D2D) communication that is supported by recent *cellular standards* and can enable communication between vehicle networks, local traffic networks, and with connected devices such as smartphones and personal wearable devices.

ITS and C-ITS solutions for VRUs have historically been developed or adopted by original equipment manufacturers (OEMs) in the automotive sector, or by transport operators, for example haulage companies or bus companies. Their aim is to improve safety for VRUs, but with the technology based around collision avoidance / early warning systems provided by V2X technology or in-vehicle systems and adaptive driver assistance systems (ADAS), or augmentative systems (such as that developed by *Spoke*), it is commonly the driver that is made aware of the VRU, whilst the VRU tends to be a passive recipient of prescriptive solutions. This is even the case when providing VRUs with communication devices or sensors, or via person-to-vehicle (P2V) smartphone-based detection, which warn other road users of conflicting trajectories, notwithstanding technical requirements for such devices, like power consumption, sensor accuracy and calculation capabilities, as well as privacy and data security (Scholliers *et al*, 2017). Confusingly, such solutions often refer to the VRU as being ‘active’ (*Car2Car*).

While C-ITS systems will continue to build on the infrastructure that is being deployed for vehicles and will provide additional applications that are beneficial for VRUs, major efforts are required to overcome technical challenges, such as message standardisation, improved location accuracy methods and device miniaturisation technologies. Deployment of appropriate systems requires collaboration between all stakeholders, including local authorities, the automotive industry and VRUs themselves (Scholliers *et al*, 2017). As noted, there remains a clear imbalance between drivers and VRUs, with the driver the chief beneficiary of technological advance. It is important to start enfranchising the VRU to make them more equal users of road space. V2X systems must incorporate various characteristics of target user groups and scenarios and make them more active participants, possibly through V2P innovations (Sewalkar and Seitz, 2019). There is also a need to look beyond safety in the form of reducing road casualties to other policy goals, such as increasing active travel, improving mobility for VRUs, and more generally prioritising non-motorised transport, especially in urban areas.

An early milestone in addressing this imbalance, targeting VRU safety, mobility and comfort, was the VRUITS project (EC 7FP, 2013-16). VRUITS analysed different ITS, suggesting VRU-centric practices, which were then field tested and piloted (Malone *et al*, 2017; Mans *et al*, 2017):

- Infrastructure based ITS - Intelligent Pedestrian Traffic Signal (IPT), Crossing Adaptive Lighting (CAL) and Information on Vacancy of Bicycle Racks (IVB)
- Vehicle based ITS - Blind Spot Detection (BSD), Pedestrian and Cyclist Detection System + Emergency Braking (PCDS+EBR) and VRU Beacon System (VBS)
- User-centric ITS - Powered Two Wheeled on-coming Vehicle Information System (PTW2V), Bicycle to Vehicle Communications (B2V), Green Wave for Cyclists (GWC) and Intersection Safety (INS)

Overall, the study of the 10 systems determined that seven returned benefits that outweighed the cost of implementation. The pilots also revealed areas that would need further focus:

- better accident data to contribute towards optimum systems
- system-wide rather than individual component strategy
- improved VRU detection accuracy
- improved user interface design
- devices that can adapt to environmental conditions and are enabled with multiple, cooperative functions
- proper procedures for data usage, standardised systems and legislation enforcement (where necessary)

This report will now focus on key areas that can provide safe, independent mobility for VRUs. It will pay special attention to PRMs. It will look specifically at solutions that are within the remit of local authorities and that can contribute to wider local policy objectives including safety, environmental sustainability, health and wellbeing, and economic participation, in other words wider benefits to society.

Multi-Modal Travel Information Services (MMTIS)

Multi-Modal Travel Information Services (MMTIS) in Europe are regulated through the ITS Directive and the *Delegated Regulation 2017/1926* (EC, 2017). MMTIS should be personalised where possible for VRUs, especially PRMs. The heterogeneity of this group means that products and services, especially ICT, must be bespoke (i.e. adaptable by or for individuals).

The Final Report for Mapping Accessible Transport for Persons with Reduced Mobility Study (Carvalho *et al*, 2020) aimed to measure progress in the provision of MMTIS for PRM. It reviewed the status quo regarding services commonly provided in Europe within the Digital Travel Information Services (DTIS) context. 125 digital tools were analysed, with their services assessed against a common framework. 41% of the analysed DTIS do not provide any PRM-specific information.

Challenges faced include the low quality of data, the lack of common data formats, the absence of profiles and standards for certain data files, the lack of existing common interfaces, and the lack of common interfaces or dynamically linking travel information services.

The study highlighted the need for:

- Better data concerning accessibility features to ensure reliable journey planning
- Standardisation in the use and understanding of data formats, data quality and access
- Clear feedback mechanisms that can identify problems and request users' support to improve the services
- Data fusion processes to amalgamate and process information from a range of sources, where currently it is virtually impossible to carry out accurate route accessibility planning with the data available
- The European Commission to take further actions through communication and support actions for data collection and harmonization
- Guidance on the minimum requirements and standards for information for PRM, to be undertaken as priority in parallel with improvements to physical accessibility and passenger rights
- Action at a local level, possibly linked to SUMI (Sustainable Urban Mobility Indicators) projects, which include "Accessibility for mobility impaired groups"

The report establishes key roles for stakeholders including the EC, Member States *and local and regional authorities*, who should define a framework for PRM digital accessibility data establishing minimum levels of standardised data that need to be provided and shared and its regular monitoring through public service contracts.

In summary, this study revealed that there is still a long way to go before achieving seamless accessibility for PRM through digital information systems. It is important to define the minimum requirements that journey planners must fulfil and at the same time plan a suitable monitoring procedure to verify the implementation of the defined requirements.

Door-to-Door Transport

Door-to-Door transport is of necessity multi-modal, and inevitably involves an active (usually pedestrian) component, which can often pose accessibility and safety challenges for VRUs. Mobility as a Service (MaaS) schemes could offer a solution; however, they are dependent on DTIS for information and ticketing. *MaaS* integrates various forms of transport services into a single mobility service accessible on demand, offering added value through use of a single application for booking and payments. Facilitating multimodality in cities to accelerate the shift to sustainable mobility is a core EC objective, with efforts to contribute to the last mile, enabling door to door travel, of significant potential benefit to VRUs; however, initiatives need to be accessible to PRMs, who could significantly benefit from the enhanced mobility and independence. Accessibility relates to DTIS, specifically a higher reliance on smartphones, but also on non-DTIS developments including less regulated transport modes (i.e. on-demand services, shared modes, electric scooters, shared bicycles, etc).

In India, the Delhi government has launched a common mobility card '*ONE'* which can be used by people for travelling by public transport. The government will also launch an app through which commuters can plan multi-modal trips. The 'ONE' card is designed to be visual, with a background of a cubic grid in bright shades of red and yellow and a circular unit with sketches of metro trains, buses, auto rickshaws and monuments/points of interest. This will help to provide people with a seamless, high-quality travel experience by public transport.

Transit oriented development (*TOD*) is another policy objective gaining prominence across the globe. The aim is to encourage citizens to walk or use public transport. TOD creates a balanced mix of land use through concentrated residential development at a walking distance of a certain radius (e.g. 500 to 800 m) along a transit corridor, or from a stop/ station. TOD is regarded as a sustainable development practice, increasing walkability, public transport use, and last-mile mobility options such as cycle sharing. Last mile connectivity around metro and rail stations will become accessible for all.

Micro-Mobility (e-scooters, bicycles, etc.) can offer highly flexible last mile connectivity. However, some of these innovations may lack accessibility for PRMs and as they become more commonplace may conflict with pedestrians as they share the same infrastructure. Whilst highly desirable from healthy mobility and sustainability perspectives, micro-mobility contributes to the complexity of urban traffic networks, and undoubtedly challenges the safety of vulnerable road users.

Despite the complexities surrounding the component parts of MaaS, it is highly likely that by combining streamlined digital payment systems, multiple modes and last mile connectivity, successful door-to-door services will become more commonplace in the next five years.

Automation

The development of autonomous vehicles (cars, pods, taxis) within smart cities could potentially reduce traffic emissions, congestion, and accident rates. Additionally, they may potentially benefit older people or PRM and help them to maintain mobility, contributing to healthy independent ageing. Autonomous cars (SAE Level 5) are able to perform all safety-critical driving control and to monitor driving for an entire journey under all conditions; human driver interventions are not required at any time during a journey (*SAE, 2014*). Such cars are designed to perform a safe and efficient automated driving in the presence of variations in the driving environment due to the involvement of other traffic users, such as other vehicles, pedestrians and cyclists. At the present time, SAE 5 vehicles are unlikely to be widely deployed in the short or medium term, although it is highly likely that SAE 3 or SAE 4 vehicles will become commonplace in non-public road environments, such as business parks and manufacturing sites, within the next five years.

Near-to-Market Innovative Solutions for VRUs

This section presents a selected examples of near-to-market solutions for VRUs. The solutions are grouped into the following categories:

- On-vehicle (VT Turnsign and VTTURNALARM)
- On-bicycle (Seesense)
- App-based (GreenCatch, and Wheelmap)
- In-road (California pedestrian lights)

For each example a summary, background and use case analysis is provided. The purpose of the use case analysis is to:

- overview how the example operates as a system, and the impact it delivers
- Illustrate how individual market solutions relate to the use cases presented in the Manual for Smart Streets

Accordingly, these analyses have a similar structure to the *Manual for Smart Streets use cases*.

VT TURNALARM

Summary

VT TURNALARM is a visual and audible alarm that alerts VRUs (specifically cyclists) of the two blind-spots associated with large vehicles. It is a system that makes the VRU 'active' and benefits both VRU and driver.

Background

Due to the extensive blind spots on large commercial vehicles, the drivers sometimes do not have clear enough visibility around their vehicle. Incidents involving VRUs frequently happen when large vehicles perform a turning manoeuvre. The VT TURNALARM system prevents accidents and protects VRUs in difficult driving conditions by specifically warning VRUs of the vehicle's intentions when they are performing a turning manoeuvre. (ref: *https://www.vision-techniques.com/all-products/vt- turnalarm/).*

Use case analysis

Objectives

- To provide an effective alarm in visual and audible modality to VRUs about the intention of the vehicle
- To enhance the safety of VRUs
- To improve driver 'visibility' and thus enhance the safety of large vehicle drivers
- To improve road efficiency by reducing traffic incidents involving VRUs

Deployment examples

- Vision Techniques secure £1 million Veolia cyclist safety investment: *https://www.linkedin.com/pulse/20141112105125-245000206-vision-techniques-secure-1-million- veolia-cyclist-safety-investment/#*
- Hyndburn Borough Council's (UK) new waste and recycling fleet trucks are equipped with the VT TURNALARM System: *https://www.skiphiremagazine.co.uk/2020/09/14/sfs-to-the-rescue-following- hyndburn-arson-attack/*

Policies

This type of system can contribute to:

- Promoting active travel
- Enhancing safety of VRUs
- Improving safety of large vehicles sharing road space with VRUs

Qualitative benefits

- This type of system can generate safety benefits for cyclists and large vehicle operators/ drivers

Quantitative benefits

- This type of system can generate measurable safety benefits for cyclists and large vehicle operators/ drivers through reduction in near-misses, collisions/ accidents
- This type of system can accelerate transition to active travel, via enhanced safety benefits for cyclists

Actors

- Large vehicle operators and drivers
- Technical partners – Vision Techniques (VT)
- Cyclists (individual and user groups) – engagement and promotion

Architecture

(ref: https://www.vision-techniques.com/all-products/vt-turnalarm/)

VT TURNALARM utilises VT TURNAWARE, a blind spot camera system that uses video analytics software to detect VRUs moving towards the vehicle and automatically informs the driver of their appearance. VT TURNAWARE detects VRUs through ultrasonic sensors installed on the vehicles and initiates alarms both visually and audibly to the driver with a digital indicator situated within the cab. Meanwhile, VT TURNALARM warns the VRUs by both visual (illuminating high-intensity LEDs), and auditory (emitting a beeping noise and announcing a pre-recorded warning: 'Caution: this vehicle is turning left') modalities.

Data Types

- Change in number of near misses between VRUs and large vehicles
- Change in number of collisions/accidents between VRUs and large vehicles
- VRU's behaviour data when reacting to VT TURNAWARE warnings
- Driver's behaviour data when receiving the alerts of VRUs presence in and around the vehicle's blind spots

VT Illuminated Cyclist TURNSIGN

Summary

VT TURNSIGN is an illuminated warning sign attached to the rear of a road vehicle designed to attract the attention of VRUs (cyclists and motorcyclists) that approach a vehicle when it is about to perform a turning manoeuvre across them (left in the UK). Although the sign is attached to road vehicles, the VRU is the receiver of the visual alert, and as such is 'active'.

Background

Statistically, one of the most dangerous activities for a cyclist is to undertake a vehicle on its left-hand side, with the cyclist/ motorcyclist highly likely to fall into the blind spot of the vehicle driver. An effective method of alerting the cyclist is to use high-intensity warning flashes that could easily catch the cyclist's attention, enabling them to be aware of that the vehicle is about to perform a turning manoeuvre. Tests have been conducted showing that using high-intensity warning flashes that are visible at eye-level is the most effective way of warning a VRU (*https://www.vision- techniques.com/all-products/vt-illuminated-turnsign/).*

Use case analysis

Objectives

- To increase cyclist/ motorcyclist awareness of vehicles performing a turning manoeuvre
- To reduce accidents involving VRUs and vehicles
- To enhance road efficiency by reducing accidents

Policies

This type of system can contribute to:

- Promoting active travel
- Enhancing safety of VRUs

Qualitative benefits

- This type of system can generate safety benefits for cyclists/ motorcyclists and vehicle drivers

Quantitative benefits

- This type of system can generate measurable safety benefits for cyclists/ motorcyclists and vehicle drivers through reduction in near-misses and collisions/ accidents
- This type of system can accelerate transition to active travel, via enhanced safety benefits for cyclists

Actors

- Vehicle drivers
- Technical partner – Vision Techniques (VT)
- Cyclists, motorcycles (individual and user groups) – engagement and promotion

Architecture


(Ref https://www.vision-techniques.com/all-products/vt-illuminated-turnsign/)

The device is waterproof and is built using a light-weight aluminium frame. It is a durable solution attached to road vehicles that can contribute towards reducing the risk of incidents with cyclists, motorcyclists and pedestrians.

The sign has been developed as a modular device – the vehicle driver can choose between three different options of illumination. With high intensity LEDs this gives greater coverage in all lighting conditions.

Data Types

- Change in number of near-misses between VRUs and vehicles
- Change in number of collisions/accidents between VRUs and vehicles
- VRU's behaviour data when reacting to VT TURNSIGN warnings

GreenCatch – an App for cyclists to catch a green traffic light

Summary

GreenCatch is a cellular multi-modal application designed to benefit cyclists equally with other road users. The GreenCatch App has been deployed in Copenhagen, the largest city in Denmark with a population of more than 1 million residents in the Greater Copenhagen Area.

Background

Copenhagen possesses a large share of cyclists compared to other modes of transport. More than 60% of residents commute by bike, while more than 40% of all commuting trips (including commuting by non-residents) are done by bike.

The GreenCatch app was made available for Android in December 2020 with an iOS version deployed in April 2021.

The main service available for cyclists through GreenCatch is Green Light Optimised Speed Advisory (GLOSA), deployed at >100 intersections. GLOSA is seen as the flagship service to drive the adoption of the app and therefore the other services (such as road works warning) which are bundled together with GLOSA in the same app.

GreenCatch is based on location, heading, and speed of the device, as well as information from the traffic signal ahead.

GreenCatch calculates a speed range within which the cyclist will catch the green light and informs the cyclist how to adjust their speed in order to catch the green light.

In some situations, it is simply not possible to reach the green light. Nevertheless, GreenCatch shows information with its countdown screen.

The manual for the app can be found in the tab "Information" when downloading the app through the link: *https://play.google.com/store/apps/details?id=dk.kk.tmf.greencatch*.

Use case analysis

Objectives

- To extend existing C-ITS services to cyclists
- To maintain and promote the modal split favouring cycling
- To relieve congestion for cars and bikes
- To increase efficiency of goods delivery
- To improve information to all users regardless of mode

Policies supported

This type of system can contribute to:

- Reducing congestion and managing traffic
- Promoting active travel
- Reducing emissions and exposure to improve health outcomes
- Sustainability (improving air quality/protecting the environment)

Qualitative Benefits

- This type of system can generate health benefits

Quantitative Benefits

- This type of system can accelerate transition to active travel, with resulting traffic management and congestion reduction benefits

Actors

- The City of Copenhagen – Service Champion
- Technical partners - Dynniq (back-office); Technolution (App development)
- Cyclists (individual and user groups) – engagement and promotion

Architecture and data flows

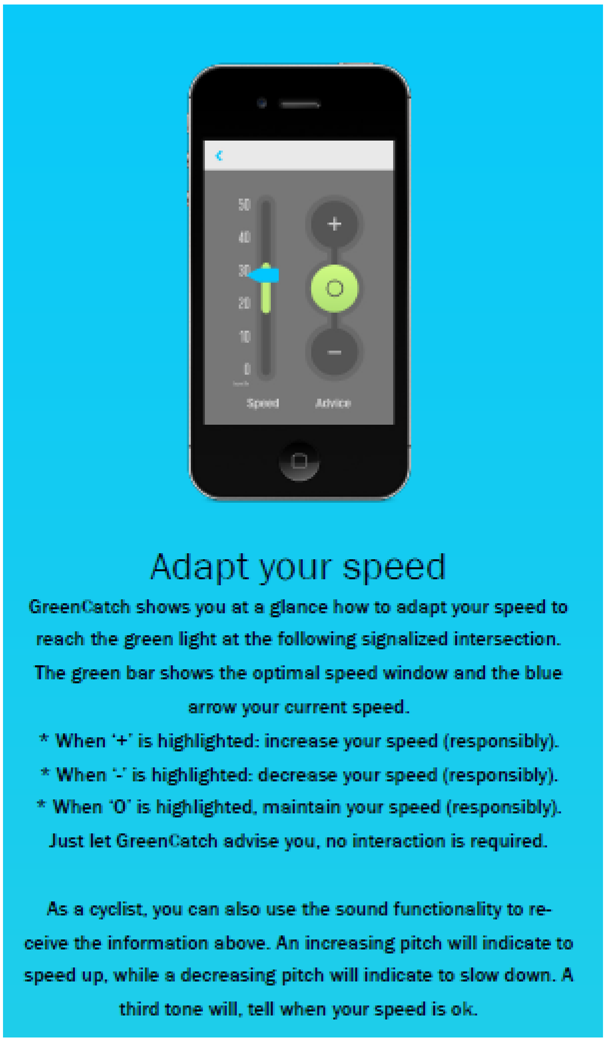
- City of Copenhagen - SPAT information for GLOSA-equipped intersections and open data feeds for RWW/RHW
- Dynniq back-office architecture builds on existing legacy infrastructure

Interfaces

The UI features GLOSA as the most visible service. An audio feature allows the cyclist to listen to speed advice through headphones (An increasing pitch means 'speed up', a decreasing pitch means 'slow down'. A third tone means your speed is ok).

On the left-hand side of the screen the user's speed is displayed as a blue arrow pointing towards a speed on a scale. If the arrow is within the green field, the user will catch a green traffic light. If the arrow is either above or below the green field within the speed scale, then the user is asked to either speed up or slow down. On the right-hand side of the screen there are three circles with a +, 0, or – sign, each of which corresponds with the speed advice given in relation to the left-hand side speed scale and green field.

When speed advice is given, this is also indicated with a pop up in the bottom of the screen saying either 'speed up' or 'slow down'.



GreenCatch App

Standards

The GreenCatch App is available in Android and iOS.

Future Developments

In the Copenhagen deployment, more intersections will be included in the service, up to a maximum of 400.

Wheelmap

Summary

Wheelmap is an app-based online system that helps VRUs to search for, find and mark wheelchair-accessible places.

Background

VRUs-wheelchair users with limited mobility may require a range of facilities to support their travel, for example, rest stops, accessible toilets, accessible parking spaces, accessible public transport. It could be difficult for wheelchair users to find reliable and useful sources of information about outdoor wheelchair accessibility to decide suitable travel routes (ref *https://www.ramblers.org.uk/advice/walking-with-a-disability-or-health-issue/people-with-limited- mobility-and-wheelchair-users.aspx*). Wheelmap is designed to solve this issue.

Use case analysis

Objectives

- To maximise VRU's (Wheelchair users) mobility
- To enhance cities' accessibility for disabled VRUs
- To improve social inclusion

Benefits

The benefits of Wheelmap in improving VRU's mobility and accessibility has been recognised. It has been awarded 2012 World Summit Award and 2014 The first European Award for Social Entrepreneurship and Disability.

Policies

This type of system can contribute to:

- Promoting accessibility, mobility and social inclusion
- Promoting improved health outcomes

Qualitative benefits

- This type of system can generate health benefits

Quantitative benefits

- This type of system can provide measurable accessibility improvements

Actors

- App development (service provider)
- Wheelchair users – engagement and promotion

Architecture

Wheelmap.org is the map for wheelchair-accessible places. Anyone can easily find places, enter them and rate them using a traffic light system – worldwide and free of charge. Our users can already access information about more than 2.3 million places. This is only possible thanks to the support of Mapbox. Wheelmap is available on the website and as an app for iOS, Android and Windows Phones (*https://news.wheelmap.org/en/mapbox-makes-wheelmap-org-what-it-is/*).

Anyone can mark Points of Interest on Wheelmap (bus stations, restaurants, cinemas, museums, banks, government offices (etc.), according to their wheelchair accessibility. A simple traffic light system is used to rate the wheelchair accessibility of a place.

Wheelmap (ref. https://news.wheelmap.org/en/about-wheelmap/)

Data Types

- Data of Places with wheelchair accessibility
- Data to quantify the wheelchair accessibility of a city
- Data for local authorities and city planner to better understand their city in terms of wheelchair accessibility

California-In-Road Warning Lights System (IRWLs)

Summary

The In-Road Warning Lights System is an infrastructural solution designed to initiate warnings to car drivers when pedestrians/cyclists are crossing the road.

Background

The system is deployed in Pacific Grove, Monterey County, California, with a population of approximately 15,500 people, on Pine Avenue, a busy four-lane roadway near a primary school. The road is wide so that pedestrians have a long journey to cross it. Drivers are likely to fail to detect the pedestrians. Reduced visibility at night had worsened the situation and increased the safety risks. A great number of near-misses and one fatality led the local authority to make the decision to implement IRWLs (system provider TAPCO). The IRWLs had previously been implemented at some pedestrian crossing and showed positive safety benefits. The high intensity, flashing LEDs of IRWLs have been shown to increase the motorists' attention and vigilance. The positive effect of IRWLs has been confirmed by a previous study (*https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1030&context=theses*) that found IRWLS doubled the yields rates of motorists and reduced the possibility of pedestrians crossing outside the illuminated zone by 10%.

Use case analysis

Objectives

- To improve VRU safety while crossing the road at uncontrolled/informal crossings
- To improve VRU safety while crossing the road at school zone crossings
- To improve VRU safety while crossing the road at high-speed pedestrian crossings

Policies

This type of system can contribute to:

- Promoting active travel, particularly walking
- Enhancing safety, accessibility and mobility of pedestrians (in this case specifically young people)
- Improving safety for vehicles sharing road space with VRUs

Qualitative benefits

- This type of system can generate health benefits for pedestrians

Quantitative benefits

- This type of system can provide measurable safety benefits (reduced near misses, collisions)
- This type of system can provide measurable increases in pedestrian activity

Actors

- Pacific Grove, Ca. – Service Champion
- Technical partners - TAPCO
- Cyclists, pedestrians, drivers – engagement and promotion

Architecture

As shown, the In-Road Warning Lights System consists of in-road warning lights embedded in the pavement and oriented to face oncoming traffic. The system activates flashing warning lights when pedestrians cross the road.

IRWLs (source https://www.tapconet.com/case-study/pacific-grove-california)

Data types

- Change in number of near misses
- Change in number of collisions
- Change in number of fatalities
- VRU crossing road frequency data
- Pedestrian crossing road behaviour data
- Cyclist crossing road behaviour data
- Drivers' response data

See Sense-Innovative Bike light

Summary

See Sense creates innovative daylight-visible bike lights that enables cyclists to be more visible in risky places such as road junctions, roundabouts, filtering in traffic and car headlights.

Background

Daytime lights offer some added visibility to all road users including vehicle drivers as well as active road users. Weather conditions, such as low-lying winter sun or fog can also impair a driver's vision, so having daytime illumination will boost visibility.

Use case analysis

Objectives

- To enhance the safety of VRUs
- To improve road efficiency by reducing accidents between cyclists and vehicles
- To reduce bicycle theft
- To enable local authorities and city planners to better understand the city

Policies

This type of system can contribute to:

- Promoting active travel
- Enhancing safety of VRUs
- Enabling local authorities and city planners to better understand the city and manage traffic through data from the deployment

Qualitative benefits

- This type of system can generate perceived safety benefits for cyclists and vehicle drivers

Quantitative benefits

- This system can generate measurable safety benefits for cyclists and vehicle operators/ drivers
- This system provides accurate cycle theft data
- This system provides real data direct to local authorities to contribute to better informed decision making

Actors

- Service provider
- Cyclists – engagement and promotion
- Local authority

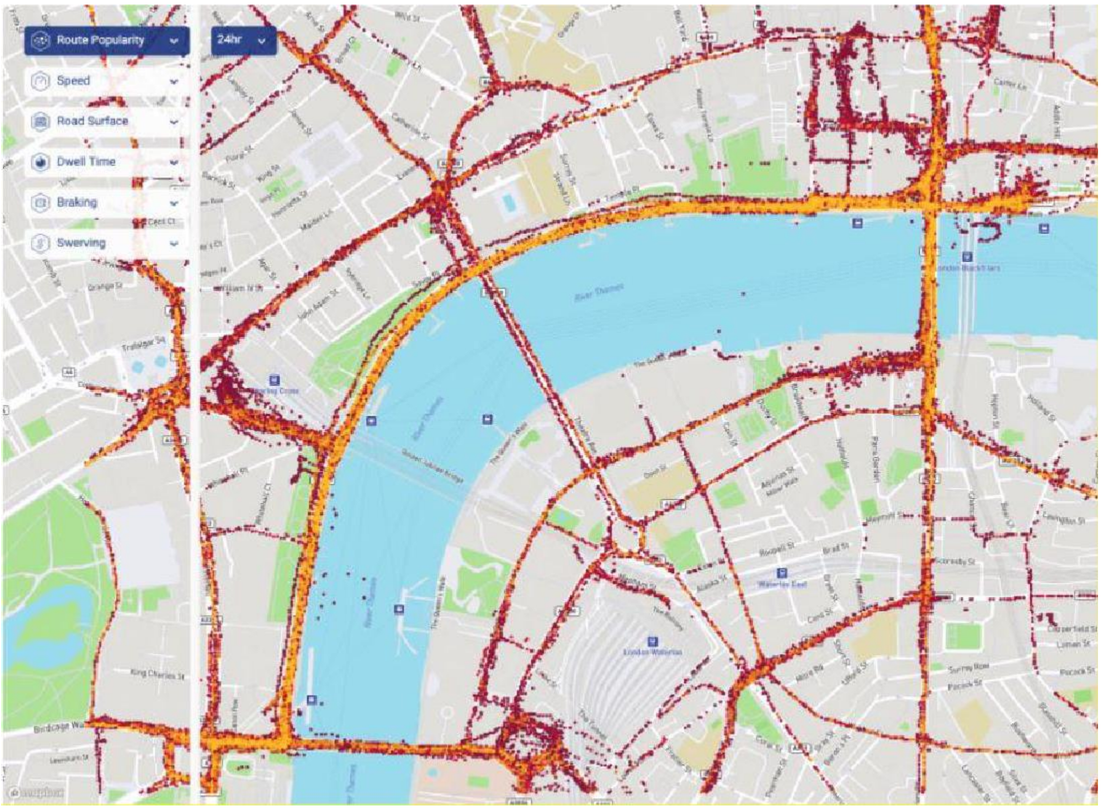
Architecture

SMARTPHONE INTEGRATION: the system integrates with smartphones, with control of the ICON lights using the optional app.

See.Sense bike lights connect via a low-energy Bluetooth device to a free companion app available on smartphones. With the use of edge processing and artificial intelligence (AI), the data is already partly processed before it reaches the app, so analysis happens as near to real time as possible.

THEFT ALERTS: the ICON's smartphone App also has an early theft alarm in case anyone tries to steal the bike.

SeeSense Innovative bike lights (source https://cyclingindustry.news/see-sense-rospa-partner-birmingham-study/)



See-Sense cyclists data for London (source https://blog.aboutamazon.co.uk/innovation/the-bike-light-start-up-revolutionising-the-way-we-ride)

<u>Data Types</u>

A crucial and innovative aspect of SeeSense is that it also creates data for local authorities and planners to better understand the roads in cities by understanding how cyclists are travelling.

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