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Professional paper

VETSOL - ENERGY ISLAND IN TRAFFIC

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Abstract

The application of sophisticated technical solutions makes it possible to increase security in modern, smart cities. VETSOL represents an energy island that should enable the achievement of self-sustainability in the field of traffic and structures that enable the lighting of intersections and road sections, support of light signaling, video surveillance of main highways and their intersections, as well as the distribution of information necessary for optimizing traffic in smart cities. VETSOL is a hybrid, energy structure that should enable the rational use of renewable and alternative energy sources, and is based on a wind generator that can drive the wind or the movement of air masses created by traffic, as well as a photovoltaic panel that increases the efficiency of the wind generator, and at the same time converts solar energy into electricity energy. The accumulated energy of the VETSOL plant provides a backup for the traffic signal system, provides better visibility of road sections and intersections by lighting them, powers video surveillance, which provides insight into the dynamics of traffic on certain sections, and at the same time helps to shed light on the causes of accidents. VETSOL is designed to support island operation as well as a networked global surveillance system. VETSOL combines several technical solutions that have proven to be successful in urban environments.

Keywords: *smart cities, traffic, green energy, solar panels, wind generators*

Introduction

These “smart cities” are designed to make it easier for citizens and visitors to navigate traffic, access essential services, use energy efficiently and much more. Increasingly, technology isn’t just impacting our workplaces and personal lives—it’s being leveraged across entire cities to improve and enhance a variety of public services and functions. One promising

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smart-city technology is the integration of Internet of Things devices with AI-driven traffic-management systems. These systems can significantly reduce congestion, optimize transit efficiency, and lower greenhouse gas emissions by analyzing real-time traffic data and coordinating traffic signals [1].
Smart cities can only live up to their name if they employ smart grids for energy sustainability. Smart grids can effectively rationalize the distribution of power in a grid, personalize energy distribution according to users' past behaviors and patterns, and instantly detect anomalies that can foreshadow a potential outage. Supply and demand become efficiently balanced and optimized.
One emerging smart-city technology is the integration of distributed energy resources with advanced clean-energy grid-management systems such as solar panels and wind turbines. By using these resources alongside advanced management systems, cities can facilitate more efficient energy usage, avoid power outages and help citizens lead happy lives.

Nearly every aspect of human life has been digitized, yet bridges, tunnels, electrical and water grids, sewers, and other real-world infrastructure has been largely untouched by digital transforma-tion due to the lack of a crucial element: low-power, low-cost wireless sensors that can act as a seamless link between machine learning and artificial intelligence and the physical world.

Figure 1. Signaling supply system with photovoltaic panel

Existing smart city traffic support systems rely on grid power, and in rare cases some of the signaling is based on renewable energy sources as shown in the previous figure 1.

SMART SOLUTION FOR SMART CITIES

Rational use of each component within the energy island increases the efficiency of energy use and reduces undesirable effects [2].
This solution implies not only the lighting of road sections and intersections but also individual monitoring of each lighting element. Using **smart lighting (Figure 2)**:

- Increase the visibility of people and objects,
- Increase the conspicuousness of signaling elements,

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- Increase the safety of drivers and pedestrians,
- Gains greater reliability and security due to permanent monitoring,
- The system is easy to maintain due to self-diagnostics,
- Individual monitoring of groups of lighting components reduces operating costs
- Enables periodic dimming of lighting intensity, which reduces energy consumption.

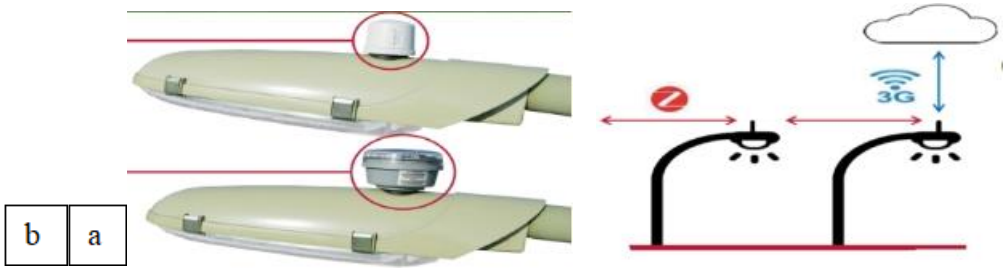

Figure 2. a) ZigBee node Ballast independent light sensor b) 3G modem light sensors

VETSOL AND ADVANTAGES OVER EXISTING SOLUTIONS

Realized models show how the geometry and structure of VETSOL affects the use of renewable and alternative energy sources (Figure 3). A vertical axis wind generator converts wind energy into electrical energy. The wind turbine is a base for applying a flexible photovoltaic panel and also represents a solar panel. Air deflectors increase the efficiency of the wind generator directing the air towards the active side of the turbine. The air deflector is a solar panel with two faces that can be fixed or adjusted (orientated) so that it helps the wind generator as much as possible or orients the photovoltaic panel so that solar energy is used to the maximum. The configuration of VETSOL is suitable for installation at intersections so that it can use air masses whose movement is initiated by the movement of the vehicle. On top of VETSOLA, there can be an additional panel for power generation or a screen that provides support in traffic regulation, or the same configuration can be placed in the place where it represents an informational advertising system. If the camera is placed on top of the device that powers it, monitoring of dislocated sections of the road is ensured. Essential unit is a microcomputer that enables the collection, processing and sending of information. With the presence of a wireless interface we complete the structure.

VETSOL introduced emerging smart-city technology that integrate a distributed energy resources with advanced clean-energy grid-management systems such as solar panels and wind turbines. The use of Vetsol devices leads to the harmonious use of wind and solar energy with a significant increase in the efficiency of the use of renewable energy sources compared to typical solutions that consider only one type of energy conversion into electricity. The possibilities of their parallel use with mutual support are considered here, which will be recognizable in the offered solution.

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Figure 3. VETSOL device

Here, not only the possibility of using several forms of renewable energy sources is considered, but also the way of their mutual support and integration into one rational device. VETSOL combines the possibility of using wind energy, solar energy and the energy of air masses moved by traffic. It is realistic to expect that at least one of the mentioned sources will be available, which gives us stability in supplying energy to the environment in which the device itself is installed, namely busy roads. Especially emphasize the advantages of the dual energy generation system.
VETSOL supports multiple smart technologies that enable:

- Rational energy accumulation – **smart charger**

- Full control of every lighting element in the environment - **smart lighting**

- Distribution of relevant traffic data to every vehicle in the area - **smart monitoring and guidance**

- Integration of distributed energy units with the standard grid - **smart energy**

VETSOL tends to achieve direct communication with the development of a communication interface for the distribution of information to all vehicles such as: Signal Phase and Timing Information. Emergency Vehicle Priority. Green Light Optimal Speed Advisory. Imminent Signal Violation Warning. Traffic Light Prioritization, – **smart communication**

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CONCLUSION

The VETSOL device has a wide range of applications, and we will mention only some possibilities of its application in traffic:
As with the previous device, with the electricity generated on the mentioned device, we enable:
Power supply for lighting roads and intersections, and it also has a SMART LIGHT option that ensures controlled lighting of each lighting fixture. Backup signaling system support in case of power failure. Power supply support for auxiliary signaling devices (information panels, warning signs, danger signs). Expansion with a new connection with each vehicle for easier monitoring of the situation at the intersection encountered (recommended speed for passing through a green light without stopping, encountering a priority vehicle, conditions at the intersection, dynamics of traffic flow, other recommendations). Support for video surveillance work, which enables insight into the flow of traffic, as well as the inspection of vehicles that commit violations or have been involved in traffic accidents. Help with watering the plants located on the traffic island.
- Information system and communications support for future autonomous vehicles.
- Power supply of electric buses at the stop, especially at the end stations (turnpikes).
- Use for electrical power supply of lighting, with the fact that the entire construction is realized as a sound wall to protect the inhabited part from traffic noise.
- Power supply of advertising panels in the immediate vicinity of roads.

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