ТЕЗИ СТЕНДОВИХ ДОПОВІДЕЙ ТА ВИСТУПІВ УЧАСНИКІВ КОНФЕРЕНЦІЇ

HIGHLIGHTS OF REPORTS AND PRESENTATIONS OF PARTICIPANTS TO THE CONFERENCE

data confidentiality is provided through priorities.

8. Building a smart home system based on ESPHome requires certain knowledge from the developer, but opens up prospects for creating an individualized and tamper-proof system.

Comparing the ESPHome, Apple Home, and Google Home ecosystems, we can highlight the advantages of ESPHome as a decentralized, open-source platform for creating firmware for Do It Yourself (DIY) smart devices, which prioritizes local control. Apple and Google, on the other hand, offer commercial cloud ecosystems built around their own hubs and centralized services.

To determine the functionality of the smart home subsystems, the work uses modeling methods based on UML diagrams to describe static and dynamic aspects, and Fuzzy Cognitive Maps (FCMs) to analyze the internal dynamics of the system. This approach allowed us to create a holistic set of models as an architectural basis for further implementation. The conceptual model, which is created in the form of a UML use case diagram, defines the actors, system boundaries, and key system functions. The physical model, represented by a deployment diagram, describes the hardware architecture. For the analysis of dynamics, a cognitive model is proposed in the form of an FCM, the modeling of which allows us to analyze the relationships between key components and determine priority areas for system improvement. The behavior of the system for key scenarios is illustrated by dynamic models created using UML Sequence and Activity diagrams.

The conducted research shows the importance of using modeling methods such as UML and FCM to create a balanced and logically consistent architecture of a smart home based on ESPHome. The key aspect is to identify a compromise between maximizing the comfort of the residents of a smart home and minimizing energy consumption. An effective solution to this problem is possible only with the help of intelligent algorithms capable of making decisions regarding the adaptability of the smart home system. The conclusions drawn on the basis of system modeling allowed the work to formulate key areas of designing a smart home based on ESPHome. In the future, the integration of the designed system into Node-RED should contribute to the creation of an intelligent and user-oriented smart home system.

References

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DESIGN OF A SMART TRAFFIC LIGHT CONTROL SYSTEM BASED ON FUZZY COGNITIVE MAPS

In modern cities, there is an increase in the intensity of traffic flows and congestion, an increase in the level of accidents and a decrease in road safety. Traditional traffic light systems that operate on fixed cycles do not consider the dynamics of the traffic situation and are therefore often ineffective [1]. This highlights the need to create intelligent control systems that can adapt the duration of traffic light phases depending on real-time conditions, the presence of pedestrians, the appearance of emergency service cars and the presence of emergencies.

A smart traffic light has access to network communication with other traffic lights, an external dispatch service, and cloud environments, unlike a traffic light that operates thanks to a local automation system. The presence of certain sensors and actuators (mandatory components of a smart traffic light) does not make a regular traffic light truly smart, but, of course, it expands the possibilities of making more informed decisions if the traffic light has certain computing capabilities. A smart traffic light must be provided with autonomous power supply for a certain period and be able to receive additional power to replenish the electricity supply. Thus, the necessary conditions for defining a smart traffic light are the presence of computing capabilities, sensors and actuators, autonomous power supply, and Internet connection. The presence of a traffic light connection with the Internet ensures the transition of the traffic light to the category of intelligent traffic lights, because in this case the traffic light not only gets the opportunity for a more advanced representation of the state of the environment, but also gets access to cloud environments with powerful computing capabilities. If the computational capabilities of the traffic light are sufficient to use machine or deep learning algorithms, then the use of edge computing is possible. Certain requirements for the quality of communication with the Internet are essential for an intelligent traffic light.

Timely response to an emergency requires the presence of 5G.

Determining the level of intelligence of a particular traffic light and creating databases of patterns of normal and emergency situations are priority tasks for research.

The thesis proposes an approach to designing a smart traffic light based on the use of Fuzzy Cognitive Maps (FCM) [2]. The approach allows formalizing cause-and-effect relationships between key factors: traffic density, time of day, presence of pedestrians, category and extremeness of incidents, equipment reliability, and the level of satisfaction of pedestrians and drivers. The description of different views on the smart traffic light control system using UML diagrams (Use Case, Deployment, Activity, Sequence) made it possible in this work to determine the scenarios of the traffic light operation and the logic of interaction of its components. Scenario modeling was conducted in the Mental Modeler environment, which showed the effectiveness of the developed system. In the "pedestrian comfort" mode, a reduction in waiting time at the crossing was achieved; in the "driver comfort" mode, the average idle time of transport was reduced; the compromise mode provided a certain level of satisfaction for both categories of participants; in case of emergency situations, the system correctly prioritized the movement of emergency service cars.

Special attention was paid to modeling possible emergency situations that must be considered in adaptive traffic light control. The study allowed us to identify emergency situations in this work to which a certain traffic light can't respond satisfactorily without the appropriate level of intelligence.

For example, among the situations that are considered emergency, we can consider situations caused by certain weather conditions (excessive precipitation, ice, fog, very high or very low air temperature together with certain humidity values, strong wind, powerful lightning). The presence of certain sensors (video surveillance systems, weather, visibility and road condition sensors) in a smart traffic light, as well as computing capabilities, allows the smart sensor to collect, analyze, detect changes in the traffic light environment and adjust signaling modes in almost real time, even considering the possible change in the emotional state of drivers and pedestrians. But the use of certain communication networks for Internet access by a smart traffic light expands the capabilities of a smart traffic light not only by adding information about weather conditions and emergencies outside the operating area of a single traffic light in a smart city, but also by software remote control of the traffic light or even manual intervention of the operator in changing the signaling mode from the transport center of a smart city. Considering emergency weather conditions, the traffic light requires more reliable equipment for both the traffic light itself and the reliability of all hardware and software components of a smart traffic light.

The obtained results of modeling the operation of a smart traffic light confirm the feasibility of using FCMs for adaptive traffic light control.

Further research should be directed to modeling the integration of hardware and software of the system, including the use of reinforcement learning algorithms for the smart traffic light control system.

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ON THE ISSUE OF IMPROVING THE TRANSPORT AND LOGISTICS INFRASTRUCTURE FOR FREIGHT TRANSPORTATION IN UKRAINE

The optimization of transport infrastructure has a positive impact on the environmental situation, while the utilization of transit potential contributes to an increase in government revenues. Global experience demonstrates the need for continuous improvement of transport systems at both national and international levels to ensure effective interaction among participants in the transport process.

One of the key ways to enhance the competitiveness of enterprises is the development of logistics centers. Ukraine benefits from a favorable geographical location, positioned at the crossroads of trade routes between the European Union and the countries of the Customs Union. As such, an important area of research is the adaptation