FinEst Centre for Smart Cities

SMART CITY CHALLENGE 2024
Solution idea for the city challenges

Max 3 pages
send to smartcity@taltech.ee by Sept 16, 2024

Solution Idea Title (max 5 words, no acronyms) – Convolutional Socio-Ecological Well-being Network
Planned pilot project duration – 36 months
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1. Which urban challenge or problem are you planning to provide a solution to?

- Which city challenge/-s proposed by the cities / counties you are targeting? NB! Please choose one from the list of urban challenges chosen for the Smart City Challenge 2024, i.e. Round 4.

  Healthy City: Urban environment design and social interventions with community engagement
  Target City: Saaremaa, Estonia and Yamaguchi, Japan

2. The solution you are proposing

- What is the solution you are proposing for the challenge above?

  Our solution centers on the dynamic interactions between people and urban environments, analyzing how these connections enhance well-being. To accurately model well-being in urban settings, we require a framework that captures the complexity of both environmental and psychological factors without oversimplification. To achieve this, we employ a multi-stage nested Bayesian network, inspired by convolutional neural networks, to simulate and interlink these intricate interactions. This approach, named Convolutional Socio-Ecological Well-being Network, ensures a balance between complexity and predictive accuracy, enabling us to model well-being outcomes effectively.

- How does it solve the city challenge you target?

  This solution tackles urban challenges by providing data-driven insights into how the environment influences individual well-being. For instance, it maps human-environment interactions by identifying factors like green spaces or noise levels and their impact on mental health. Using **Bayesian network analysis**, it integrates variables such as air quality, walkability, and community engagement with psychological factors like stress reduction. Surveys grounded in environmental psychology gather resident input on locations that either enhance or diminish well-being, enabling cities to design spaces that promote relaxation, social connection, and overall health improvement.
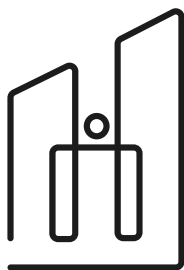
3. Innovation and piloting of your pilot solution.

- What are the best solutions available now that solve the challenge you target? (There are some solutions there for sure) How will your solution be better? What is the innovation in it?

  Currently, smart city solutions for urban health primarily address physical factors like air quality, traffic, and public health interventions. Although some progress has been made with well-being indicators, these efforts rely on generalized data and overlook the nuanced analysis of individual spaces. A notable example is Daniele Quercia's **Happy Maps**, which suggests emotionally positive routes to improve pedestrian well-being (Quercia et al., 2014). Our solution builds on this by proposing a **Convolutional Socio-Ecological Wellbeing Network**, combining psychological, social, and environmental data in real-time, offering more personalized and detailed well-being insights than existing models.

  Our approach innovates by employing a **Bayesian network** model to monitor and simulate well-being scores, integrating environmental psychology and IoT technologies for personalized well-being data. Unlike existing systems, which lack real-time analysis of psychological well-being, our solution not only monitors these factors at the same level of immediacy as physical conditions but also provides citizens with feedback on how their interactions with the urban environment impact their mental health. This fosters active engagement with urban spaces and enables cities to optimize environments for psychological well-being. Additionally, this approach encourages community-driven urban design, ensuring that the spaces where people live, work, and socialize are crafted to support their mental and emotional health in a more comprehensive way than current solutions allow.
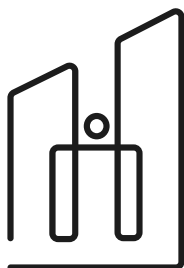
  Reference:

  Quercia, D., Schifanella, R., & Aiello, L. M. (2014). The shortest path to happiness: Recommending beautiful, quiet, and happy routes in the city. *Proceedings of the 25th ACM Conference on Hypertext and Social Me*

- What do the cities need for piloting the proposed solution? How the piloting could work?

  To pilot the proposed solution, cities need to organize resident-participatory workshops to collect detailed well-being data across various urban spaces. Utilizing mobile apps like **Epicollect5**, cities can gather spatial and social factors that contribute to well-being. It is crucial to involve universities, urban planners, and local governments to integrate this data into urban decision-making processes.

  The pilot can start in a small district, where data collected via workshops will be analyzed to understand how urban spaces impact mental health. Using **Bayesian network analysis**, the solution connects physical and psychological factors. Once the model is established, the system can identify well-being-enhancing areas and provide feedback to both residents and urban planners. This phased approach allows adjustments based on real-time data and feedback, making it scalable to other city areas.

- Please provide short information about the capabilities of the research and development proposed team. Your team should have members from TalTech as well for sure. In case you do not have them yet, which skills would you need from TalTech.

  The research and development team for this project should consist of experts in environmental psychology, urban planning, data science, and IoT integration. The team will collaborate to effectively model and analyze well-being data. While the proposer has expertise in environmental psychology, data science, and multi-layered nested Bayesian network analysis—key to this project—it is not sufficient alone. **TalTech's** expertise in urban infrastructure, smart city technologies, and AI-driven data analytics is essential. Collaboration with TalTech will enhance real-time data collection, urban design integration, and advanced statistical modeling, enabling seamless and scalable implementation.

4. Expected impact of your pilot solution.

- What is the potential impact for city environments, sustainability and citizens?

  The pilot of the **Convolutional Socio-Ecological Wellbeing Network** enables data-driven urban planning aimed at improving mental health and well-being in city environments, transforming urban spaces into healthier and more sustainable places. By incorporating psychological and well-being factors into evidence-based policy making (EBPM), this technology helps cities become healthier. For residents, it fosters deeper connections with their surroundings, promotes healthier lifestyles, and enhances mental well-being, creating more inclusive and human-centered spaces. Using this data, cities can continuously evolve toward more sustainable and well-being-focused environments.

Disclaimer: by submitting this form you will give the FinEst Centre for Smart Cities the right to share this idea with cities and other researchers, companies through FinEst Centre homepage. If this idea is selected, the FinEst Centre for Smart Cities has the right to implement this idea with offering you an active role in conducting the pilot. If this pilot is selected then the financing is an investment by the FinEst Centre for Smart Cities.

CHECKLIST AND FAQ (Delete this part before submitting)

☑Are you a researcher from another university? - Yes – you are warmly welcome to propose a solution but form a team with TalTech researchers. Need help with contacts, please ask.

>>> I would be grateful for the opportunity to team up with researchers from TalTech. As I do not have any personal connections, I would greatly appreciate it if the secretariat could assist in facilitating the introductions. I apologize for the trouble, but I kindly ask for your support. Thank you in advance for your cooperation.