УДК 186

DATA SCIENCE IN THE LIVING ENVIRONMENT

N. Klimenko

Massachusetts Institute of Technology, Cambridge, USA

Science supervisor A. Savenko

Sukhoi State Technical University of Gomel, Republic of Belarus

Summarizes the major applications of data science in the life environment, outlines key risks and opportunities, and identifies the most promising use cases within the framework of standard systems analysis.

Keywords: data science, smart home, monitoring of the daily living activities.

НАУКА О ДАННЫХ В ЖИЗНЕННОЙ СРЕДЕ

Н. В. Клименко

Массачусетский технологический институт, Кембридж, США

Научный руководитель А. Ю. Савенко

Учреждение образования «Гомельский государственный технический университет имени П. О. Сухого», Республика Беларусь

Обобщены основные области применения, связанные с наукой о данных в жизненной среде, обрисованы ключевые риски и возможности и оценены наиболее многообещающие варианты использования в рамках установленных систем анализа.

Ключевые слова: наука о данных, умный дом, мониторинг повседневной деятельности.

At its core, the use of statistical analysis and what is known today as “data science” in building technology is as old as the domain itself, with initial research done as early as relevant sensors and computation technologies became available. Overall, the use of sensors to monitor energy consumption, air quality and other engineering aspects of a built structure are well-established, non-contentious, and will steadily grow as construction techniques become more sophisticated. Among the plentiful propositions and visions of “smart home”, the major application domains identified can be divided into Healthcare, Insurance, and Design & Lifestyle Performance. While the exact applications and the end motivations of various use cases overlap, different stakeholders (insurers, developers) gravitate to different aspects of the application domain depending on their own ability to enter the market [1].

One of the most cited – and most easily studied one in the nascent literature, privacy concerns relate both to the technical ability to keep the personal data away from undesired parties as well as the set of misconceptions, prejudices, and personal preferences around sharing information with an external party. Major limitation of existing studies is the small test group sizes that have very low representability (within the literature surveyed, pilot studies run with at most 30 participants). One of the (quite obvious) observations across the studies on privacy is that participants are more likely to give up privacy if they have a better understanding of how the data is used. For example, older people were more likely to agree to video surveillance if they were provided evidence of how it could allow them to stay more autonomous alone in the house [2].

While tied to privacy, security relates to the technical capabilities of a sensing system to keep valuable information out of reach from adversarial parties. When surveyed regarding the potential adversarial actors , most respondents were concerned by an external intruder using data to commit harm rather than the corporate entity monetizing the users' data. Examples include intruders turning off valuable health devices, phishing, impersonating the owner to access more sensitive records on financial transactions or physical access, or sensitive personal data, or simply triggering malfunction of the support system. More esoteric concerns include unintended voice capture or 'dolphin attacks' (communicating malicious voice commands to a smart assistant through waves illegible by humans). Common IoT devices are particularly vulnerable since they are based on simple, low-cost equipment and have relatively simple protection measures, further complicated by reliance on updating security settings. One major strategy towards privacy and security concerns is to perform data analytics locally on the device and not share background data outside of the apartment. For example, a device that has to count occurrences of a certain event from audio footage may be restricted from sending the entire audio recording to the external server but instead compute the number of events locally and share relevant statistics. This, however, poses additional compute capacity challenges to the IoT infrastructure and further complicates the use of comprehensive data monitoring [3].

Across several of the application domains analyzed, there are several common misconceptions related to the scalability of certain solutions. The first one is data understandability. The heightened interest in the living environment sensing appears to primarily emerge from the fascination with the new volumes of data and information available, which many are eager to process with novel statistical (and AI/ML) methods. The overflow of information often occludes the understanding of measurable objectives and clear goals in the domain. In some cases, such as occupancy analysis or emergency alarms, the supply of data available far outstrips the scope of the objectives – thus, the complex applications of analytics are redundant. In other cases, the seemingly rich data collection techniques are blindingly stochastic and, despite their abundance, fail to provide coherent and sufficient explanations for the phenomena to be studied. Examples include lifestyle and health recommendations. In a nutshell, tractable data does not mean understandability: the ability to easily extract data does not mean an equally easy ability to extract good insights that bring sufficient value-add. Despite the challenges, a few application cases appear to have sufficient traction to expand further and amend the ways we occupy spaces. These include either single-use, very specific medical monitoring platforms that are to supplement medical visits (such as depression monitoring in specific risk groups) or non-contentious, mutually beneficial sponsorship of building performance equipment by insurance companies. While the anti-utopian "walls with ears" will not come about soon, it is clear that we are likely to be more aware of the data footprint of our occupied space and will have to navigate through more legal and social discussions regarding how much we share and how we may be properly compensated for it.

Those stakeholders that are directly involved in the collection and analysis of our living data may also undergo a paradigm shift. Whether the use case of data science in the living environment is strong or weak, it appears that there is a tendency to think "inside the box" – or rather, "inside the room" – that is, grasp all possible sources of data collection indoors first and subsequently decide what to do with it, which triggers projects that may either leak sufficient data or be plainly useless. With the complexity of the human lifestyles, uncertainty of the information and potential abuse, the indoor environment may better be imagined as a "black box" that we may never fully figure out. The ultimate way to deal with such "black box model" questions is to first come up with clear objectives of what has to be extracted from the living environment first and subsequently tackle the specific methodology of the process.

Referens

1. Vanus, J. Monitoring of the daily living activities in smart home care / J. Vanus // Human-centric Computing and Information Sciences. – 2017. – N 7.1. – P. 1–34.
2. Geneiatakis, D. Security and privacy issues for an IoT based smart home / D. Geneiatakis // 40th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO). – IEEE, 2017.
3. Maalsen, S. The smart home on FIRE: Amplifying and accelerating domestic surveillance / S. Maalsen // Surveillance & Society. – 2019. – N 17.1/2. – P. 118–124.

УДК 168

ИНДУСТРИЯ 4.0 И ГЛОБАЛЬНЫЕ ПРОБЛЕМЫ В СИСТЕМЕ «ЧЕЛОВЕК – ОБЩЕСТВО – ПРИРОДА»

В. Д. Козловский, В. С. Тручок

Учреждение образования «Гомельский государственный технический университет имени П. О. Сухого», Республика Беларусь

Научный руководитель А. Ю. Савенко

Рассмотрено предполагаемое влияние технологий четвертой промышленной революции на глобальные проблемы, существующие во взаимодействии человека и общества с природой.

Ключевые слова: глобальные проблемы, четвертая промышленная революция, индустрия 4.0, интернет вещей.

INDUSTRY 4.0 AND GLOBAL PROBLEMS IN THE SYSTEM «MAN – SOCIETY – NATURA»

V. D. Kazlouski, V. S. Truchok

Sukhoi State Technical University of Gomel, Republic of Belarus

Science supervisor A. Yu. Savenko

The expected impact of technologies of the fourth industrial revolution on global problems existing in the interaction of man and society with nature is considered.

Keywords: global problems, fourth industrial revolution, industry 4.0, Internet of things.

Возникновение и обострение глобальных проблем вызвано в значительной степени стремительным развитием науки и техники, все возрастающим промышленным использованием его результатов. Следует выделить следующие типы глобальных проблем: 1) интерсоциальные глобальные проблемы, относящиеся к взаимодействиям между такими социальными общностями, как общественно-экономические системы, государства и т. д. (проблемы мира и разоружения, мирового социального и экономического развития, преодоления отсталости отдельных стран и регионов и пр.); 2) антропосоциальные глобальные проблемы, связанные с отношениями между человеком и обществом (проблемы научно-технического прогресса, образования и культуры, роста народонаселения, здравоохранения, биосоциальной адаптации человека и его будущего); 3) природно-социальные глобальные проблемы, существующие во взаи-