

Solving Critical Problems in Vietnam: The role of Internet of Things

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Abstract

Internet of Things (IoT) plays an important role for solving critical problems such as climate change, smart city, smart agriculture, pollution of air, water and land. Despite being one of the leading countries in information technology outsourcing and facing a lot of critical problems of life environment and health, research and application of IoT in Vietnam are very fragmented. We thus analyze four critical application domains in Vietnam and the role of IoT for solving those problems.

Introduction

Internet of Things (IoT) is a concept of physical objects that either have the capabilities to connect to Internet or are recognized on the Internet by others (e.g., RFID reader, an embedded device). So that, on the one hand, monitoring data/status of physical object can be monitored and made available for other objects to make the Internet-based services better and accessible anytime, from anywhere. On the other hand, the object can also be controlled through these services. Currently IoT promises to revolute several application domains by enabling efficient technologies for solving complex problems. We have observed in many places the introduction of services built atop IoT technologies by leveraging IoT sensing capabilities and analytics of IoT sensing data under the so-called “IoT services” [1]. Well-known application domains where IoT services play a crucial role are: (i) smart city [2] such as traffic monitoring and recommendation, wastewater management, urbanization, lighting, public safety, healthcare and energy, etc; (ii) climate change monitoring [3], such as flood monitoring, saltwater monitoring, rising sea levels, natural disasters; and (iii) smart agriculture [4][5][6] including food safety/tracking, and smart farming. In the context of Vietnam, in particular, and in developing countries, in general, these application domains are of paramount importance for developing sustainable society and living conditions. Despite being one of the leading countries in IT outsourcing, however, applying IoT in Vietnam for solving critical problems, like food safety, traffic management, saltwater intrusion and wastewater management, are very fragmented. In this paper, we analyze four critical application domains in Vietnam and the role of IoT for solving those problems.

Four critical problems and IoT solutions

Food safety: is one of the main concerns in Vietnam [7,8]. Several unsafe cases have happened [9], such as: (i) antibiotic residues, growth promoters or heavy metals in pork; (ii) pesticide residue, nitrate, heavy metals, or micro-organisms in vegetable and fruit; (iii) fishery in polluted land and water, etc. To improve the quality of agricultural products in context of WTO, ASEAN Economic Community or Trans-Pacific Partnership in the future, The Vietnamese government encourages the farmers to follow guidelines of Viet/Global GAP (Good Agricultural Practice) or GMP (Good Manufacturing Practice). Among many issues, IoT technologies and services could be helpful, as indicated by several research works [10,11]. For example, IoT with the capacity of enable sensing is to foster the farm monitoring and product traceability.

Through IoT technologies, the information of farm monitoring and product delivering status can be captured at right time for further analytics such as combining IoT services with related information (e.g., food domain knowledge, the weather, the pollution of land, water or air), we could provide information about the quality of food [12]. IoT with data analytics can help in auto monitoring and prediction of farming conditions.

Saltwater intrusion: due to climate change as well as water resources change, the Mekong Delta region in Vietnam faces a severe problem of sea level rise [13], [14]. In addition, the problem of saltwater intrusion is emerged as an important issue that needs to monitor for the Mekong Delta region and the other regions in Vietnam. For example, in the Mekong Delta region the saltwater can encroach inland about 40-60 km, in 4-5 months [14]. This causes severe problems for water sources for living and agricultures in the region. It difficult for farmers to use the river water for irrigation, vegetable gardens and fruit trees. All of these make a huge impact on the lives of people, especially people of the coastal region (alarming rate is high). Monitoring saltwater intrusion in real-time and analytics solution would help creating novel planning, etc. Therefore, IoT services are clearly winning solutions to build a network of automatic salinity monitoring stations in the Mekong Delta region to provide real-time monitoring of saltwater intrusion. IoT services can also lead to enhancement with quick warning about changes of the salinity in some main rivers in the Mekong Delta region.

Wastewater pollution: in big cities and industrial parks is another facing problem of Vietnam [15]. One of the main reasons is that many factories are established along rivers and they produce untreated waste disposal, causing a lot of diseases and intestinal illnesses for people living in the vicinity of the river. This situation directly affects to people health and aquaculture, one of the most important exported products of Vietnam [16]. However, monitoring wastewater pollution is very challenging due to the lack of technologies. Recently, some typical cases of violation of wastewater management were only detected since their impact to environment is very big [17] [18]. Sensors for measuring wastewaters (e.g., measuring pH, Dissolved Oxygen (DO), salty, temperature, Conductivity, Turbidity, phosphorus) have been applied in Vietnam [19]. However, in Vietnam's context, it is just applied to monitor and operate for a local/individual problem. IoT services can be used to monitor water indicators, water usage, draining monitoring by leveraging IoT sensors, gateways, edge networks In general, IoT services could be provided to manage, operates and maintains the entire sewer system, wastewater lake, and wastewater treatment [20][21]. IoT services could enable tracking, monitoring, remote control valves, gates of the lake damper conditioning, rain gauge, lake water level conditioning, remote monitoring camera positions, prevent the tide of sewage pumping station, pumping station inundation. These data can be used for decision making, data services, and modeling for stable wastewater management system. The system should provide a flexible and extensible architecture for the integration and interoperability with various systems such as SCADA - Supervisory control and data acquisition, geographic, weather forecast, and environment.

Transportation in big cities: there are currently two main problems that has risen with road transportation in Vietnam: (i) quality of roads is very low as compared with actual demands [22], and (ii) vehicle and goods control and monitoring are ineffective

during transport process because the lack of applying technologies [23]. With these existing problems, improvement of transportation situation in Vietnam plays the important role in fostering economic growth. In this way, activities in goods transportation are done more quickly, and products will be delivered easily to all regions as well as customers. However, the first problem has a national scope and it is difficult to resolve immediately with several separate solutions. Instead of, Government has proposed long-term plans to improve gradually the traffic network. Many projects are performed by cooperation among private and state enterprises, Vietnamese and foreign company [24]. Conversely, the second one has received much attention from small and medium companies [25], [26] and [27] in contributing technical solutions and it makes the expectation that can be overcome the problem soon in Vietnam. In order to approach and resolve the second problem, we need to collect monitored data and make analytics to optimize transport processes. The requirement is identical with IoT features when all things are connected to exchange the collected data for a concrete purpose. However, IoT services not only help connect different vehicles but also many other devices and things, which support transportation to work together and make smart environment. The connected things for transportation can be listed such as: vehicles, toll booth, surveillance camera, goods sensors and so forth. Especially, in the context of the first problem needs a long time to overcome, IoT will help impulse to deal with the first one quickly in short-term and in this way IoT will improve transportation at Vietnam.

Conclusion

Four critical application domains of IoT were selected to analyze in this paper and they are just hot topics recently. However, the application of IoT is very wide and we believe that in a near future, IoT is a major solution for the most of problems around us, for instance: smart city, healthcare, water management, smart agriculture such as improving productivity, and education.

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