Edge Computing and IoT Technologies for Medical Applications:
A Case Study on Healthcare Monitoring

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EXECUTIVE SUMMARY

Dynamic observation of blood sugar levels is essential for patients diagnosed with diabetes mellitus in order to control the glycaemia. Inevitably, they must accomplish a capillary test three times per day and laboratory test once or twice per month. These regular methods make patients uncomfortable because patients have to prick their finger every time in order to measure the glucose concentration. Modern health monitoring systems rely on IoT. However, the number of advanced IoT-based continuous glucose monitoring systems is small and has several limitations. Here the authors study feasibility of invasive and continuous glucose monitoring system utilizing IoT-based approach. They designed an IoT-based system architecture from

a sensor device to a back-end system for presenting real-time data in various forms to end-users. The results show that the system is able to achieve continuous glucose monitoring remotely in real time, and a high level of energy efficiency can be achieved by applying the nRF compound, power management, and energy harvesting unit altogether in the sensor units.

1. INTRODUCTION

Edge computing based Internet of Things (IoT) can be viewed as a dynamic network where physical and virtual objects are interconnected together. IoT encompassing advanced technologies such as wireless sensor networks (WSN), artificial intelligence, and cloud computing play an important role in many domains comprising of robotics, logistics, transportation, and health-care. For instance, IoT-based systems for health-care consisting of sensing, WSN, smart gateways, and Cloud provide a way to remote and real-time e-health monitoring. Advances in WSNs have created an innovative ground for e-health and wellness application development. Ambient assisted living, ambient intelligence, and smart homes are becoming increasingly popular. According to the World Health Organization (WHO), the epidemic of Diabetes Mellitus (DM) in Mexico is catalogued as a national emergency. DM is a chronic non-communicable disease in which the body is unable to regulate blood glucose levels. There are two main types of diabetes: diabetes type-1 occurs when the pancreas is incapable to produce insulin, or produces only a scarce amount; insulin is essential to regulate the glucose concentration in blood and to convert glucose into energy. Diabetes type-2 takes place when the body cannot effectively use the insulin, and it is proliferating worldwide more rapidly than type-1. Standard methods for measuring the blood glucose concentration are invasive, since they require either to collect a blood sample for a laboratory test, or to prick the fingertip for a capillary test. A capillary test is often used for monitoring due to its ease of use.

However, patients require pricking their finger in different moments of the day, yielding discomfort and distress, thus hindering a proper glycaemia control. These can be combined to other health solutions such as fitness and wellness, chronic disease management and diet or nutrition monitoring applications. The new initiatives tend to be integrated into the patient information ecosystem instead of being separated into monitoring and decision processes. There are potential benefits to ageing population, where elderly people could be monitored and treated at the comfort of their own homes. Fully autonomous health monitoring wireless systems can have many useful applications. Among those applications is glucose level measurement for diabetics. Diabetes is a major health concern. According to a WHO report, the number of people with diabetes has exceeded 422 million and in 2012, over 1.5 million