Smart Classrooms for the Next Generation

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***Abstract*—Smart systems are now very much common in several applications. These systems are found in large numbers in our daily lives in the recent times. The current pandemic induced restrictions forced us to go for all kinds of smart systems which can provide both the comfort as well as the essential functions needed at the ground level. Classrooms are among the basic needs of the modern education system. There are several new developments in the commonly used technologies which can make the classrooms better and smarter. Digital technologies are the main front runners of these smart initiatives. Among these smart digital technologies, information and communication technologies (ICT) and immersive technologies are found to be the main enablers. In this article, we go through the main technologies used for smart classrooms. We show that smart classrooms are essential for the future generation. These smart classrooms can handle several limitations of the traditional classrooms. In addition to the typical teaching and learning processes smart classrooms can provide value added services to the teachers, students and other stakeholders. We analyze the long term value and sustainability of these smart classrooms.**

***Index Terms*—Smart classrooms, immersive technologies for classrooms, IoT for smart classrooms, technologies for smart classrooms**

I. INTRODUCTION

Smart technologies are very popular in recent times. There are a lot of demands for these technologies for different types of common as well as difficult tasks. Several of these smart technologies have disrupted the technology trends in the recent years. In general, artificial intelligence (AI) and machine learning (ML) are considered as the main driving forces behind the modern smart systems. However, in reality a lot of other technologies play vital roles in the smart systems. Especially the information and communication technologies (ICT) are central to many smart systems. Interaction among different parts and components is possible using ICT frame works. Interactions among the components and organs of the smart systems can be very much systematic using the Internet of things (IoT) based arrangements. Smart systems using IoT can sense, actuate, activate, deactivate, control, measure, monitor, and interact with the other systems. In addition to that they are able to collect data from their actions and surrounding. Then the collected data is analyzed for future actions. Smart systems using IoT are very much interactive with the environment. Thus it is not surprising that IoT are extensively used for smart systems across domains. Smart classrooms use several advanced technologies. Out of them the prominent are ICT, immersive technologies, and other interactive technologies. Over the last two decades, a lot of advances have been observed in virtual reality (VR) and augmented reality (AR). These technologies are suitable interactive environment such as the smart classrooms. In the recent years we found IoT is very much suitable for several tasks and functions of the smart classrooms. Now IoT is considered an integral part of real-time interactive environment.

Smart technologies have been proposed for advanced services since the last century. Of course the frameworks for these initiatives were not very clear at that time. Now with the arrival of the new tools in ICT it has become very clear on how to manage the smart technologies for emerging applications. For smart classrooms interactive tools such as IoT, and immersive technologies are preferred [1]. It is found that immersive technologies enabled through VR and AR are instrumental in the digital interactive applications. In [2], several business and transaction related applications using VR and AR have been presented with real prospective. In [3], several immersive technologies related initiatives have been discussed with their long term prospects. It shows that immersive technologies are essential for digital interactive education. There are several applications of IoT for digital ecosystem based smart environments [4] – [17]. It is widely expected that IoT has tremendous potential to change the modern digital ecosystem. Due to the arrival of multiple new applications low power IoT systems are preferred over the high energy consuming technologies. Large machine type communications using IoT over the cellular networks such as the fifth generation mobile communications (5G) are going to create a large traffic. Therefore, a specific slice is dedicated for these applications. It will be provided through