5G in Augmented Reality and Virtual Reality

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A huge variety of IoT connected devices are deployed in the close vicinity of a user creating a huge amount of data that is hard to access and interact with. In addition, with the evolution of 4K 360 video and "shared experiences" applications using AR/VR, livestreaming of such content anywhere and anytime will be a dominant challenge by communication networks. Finally, new low latency thresholds set by Industry 4.0, V2V communications and medical applications have created more challenges in modern networks. It is clear that the human to computer interface is now transformed to a new concept which is the human-to-network interface. We address this problem with a new concept of integrating real-world smart things and virtual-world avatars/objects in a computer-generated virtual environment so that entities in either worlds can interact with one another in a real-time manner. The presentation will discuss about a state-of-the-art AR/IoT platform that is developed at Texas State University that integrates a sensor network of Internet of Things (IoT) with an Augmented Reality (AR) device to create a "4D" experience. The 4D experience provides real-time spatio-temporal visualization and allow the user to interact with the IoT network in a highly intuitive and shared experience fashion. In addition, the presentation will discuss how network offloading techniques will be vital for the operation of 5G networks since they can help minimize redundant data traffic in 5G networks related to AR/VR applications.

For AR applications, one of the most data and CPU "hungry" process is object detection since it is related to feature point extraction, database searches and image transfer. One way to reduce this workload is to minimize the data transfer and database searches by designing and developing algorithms to manage those requests. We will introduce an algorithm that considers the location of the user as well as the field of view and aims to utilize these inputs to reduce a) the amount of redundant object detection function calls and b) minimize the database search by creating clusters.

For low latency aspects related to the integration of IoT with AR, we will introduce principles derived from Edge Computing. In the proposed system architecture there are three main components, as seen in Fig. 1. These are the IoT network, the edge computing server, and the virtual space. The IoT network, contains a set of connected devices in a ZigBee mesh or star topology, a coordinator and the gateway. The edge computing platform provides the computational efforts needed to maintain and interact with the IoT network while also providing a low-latency REST Application Programming Interface (API). The "virtual space" is implemented with AR device and Unity programing language and consists of virtual avatars that correspond to specific IoT devices. A use case example is shown in Fig. 2 where the user wearing an Hololens device is able to visualize the network topology captures in real time from the routing tables of the sensor network.

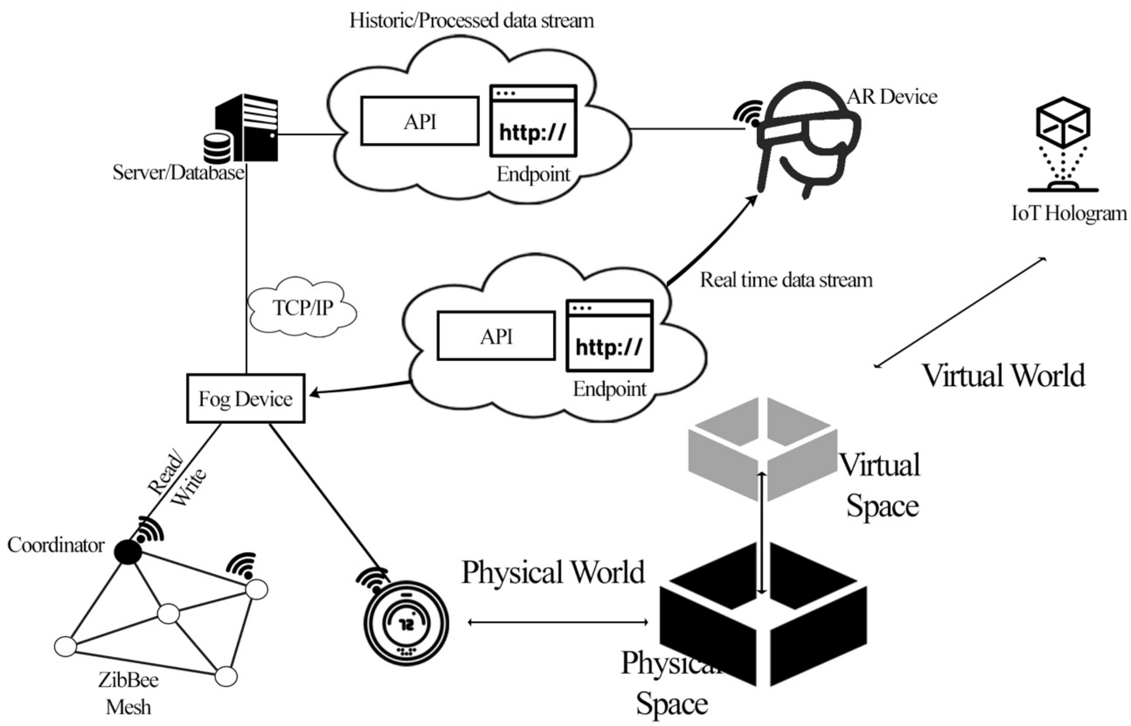

Figure 1. System architecture for IoT/AR

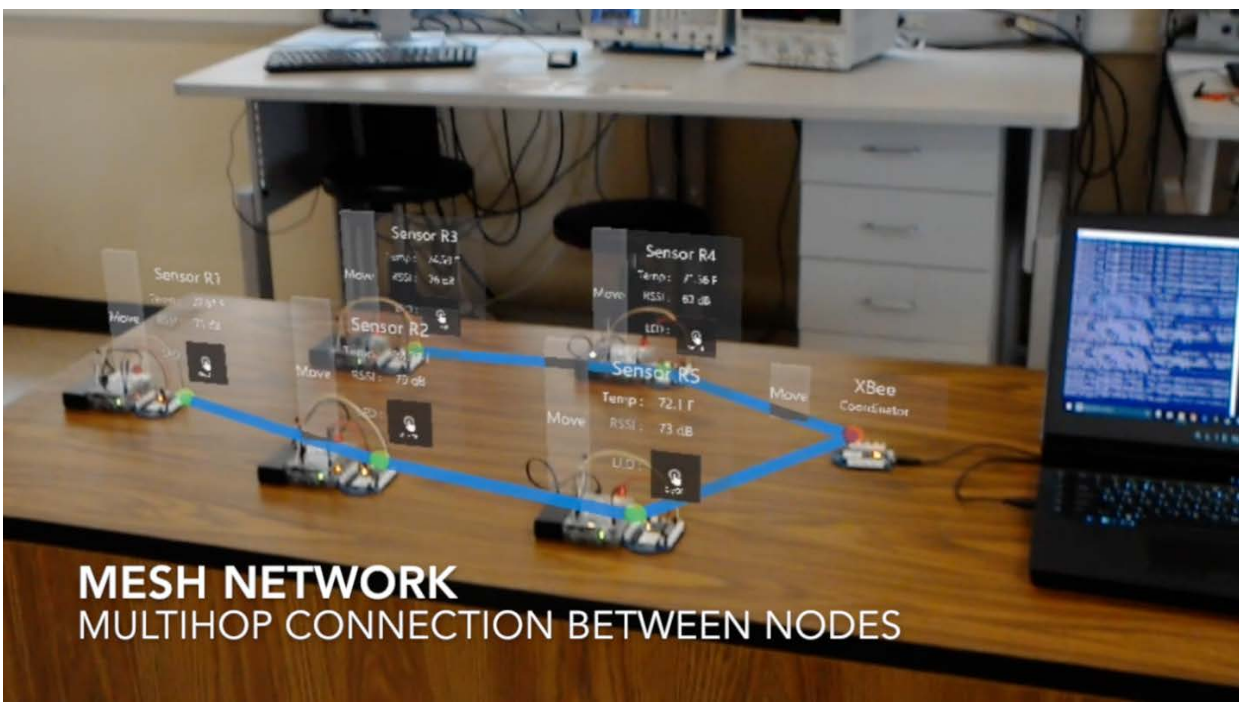

Figure 2. Screen shot of AR visualization of ZiBee network topology with holographic display of IoT data.