

# KSK COLLEGE ENGINEERING AND TECHNOLOGY

---

ENVIRONMENT AND MONITORING AND INNOVATION



Sustainable growth of the whole world depends on several factors such as economy, quality education, agriculture, industries and many others, but environment is one of the factors that plays the most important role. Health and hygiene are key components of the sustainability of mankind and progress of any country, which comes from a clean, pollution free and hazardous free environment. Thus, its monitoring becomes essential so as to ensure that the citizens of any nation can lead a healthy life. Environment monitoring (EM) consists of proper planning and management of disasters, controlling different pollutions and effectively addressing the challenges that arise due to unhealthy external conditions. EM deals with water pollution, air pollution, hazardous radiation, weather changes, earthquake events, etc. The sources of pollution are contributed by several factors, some of which are man-made and others due to natural causes, and the role of EM is precisely to address the challenges so that the environment is protected for a healthy society and world [1]. With the more recent advances in science and technology, especially artificial intelligence (AI) and machine learning, EM has become a smart environment monitoring (SEM) system, because the technology has enabled EM methods to monitor the factors impacting the environment more precisely, with an optimal control of pollution and other undesirable effects. The design of smart cities is taking the place of old and traditional methods to create and plan urban environments. Smart cities are planned using wireless networks that assist monitoring of vehicular pollution level in the city [2]. Wireless networks or wireless sensor networks (WSNs) comprise modern sensors which operate on AI based monitoring and controlling methods. Internet of things (IoT) devices are employed in WSNs for effective waste management, vehicle marking, temperature control, and pollution control. Therefore, modern methods of environment monitoring are known as SEM systems, due to use of IoT, AI and wireless sensors [3]. Assessment of burned areas using multispectral data captured through satellite imaging and remote sensing [4], mobile health monitoring systems and IoT based environment systems [5], smart marine environment systems using multimodal sensing networks [6], and many other SME methods are reported in current literature. When wireless devices are used over a WSN, then certain standards and protocols are important for effective implementation of SEM systems and thus studies are also reported on developing protocols and standards for IoT based SEM systems [7].

IoT, WSNs and suitable sensors are the backbone of the SEM systems. The WSNs provide the connectivity of the data, captured by employing sensors and IoT devices, used to record, monitor and control various environmental conditions, such as water quality, temperature, air quality, etc. A smart environment system can be easily understood with the help of an example of a cloud based SEM system, as shown in [Figure 1](#). The example shown in this figure depicts monitoring of water contamination and its control, by using a cloud based system that connects IoT devices and various suitable sensors. The system can monitor, with the help of IoT devices, if the water is contaminated or clean since all IoT devices have embedded the capability of AI and machine learning. The organization, which is involved in monitoring the water quality of various water sources, has access to the cloud through the data collected from various sensors, for example an aqua sensor, and is subjected to IoT based analysis where the quality check is done.



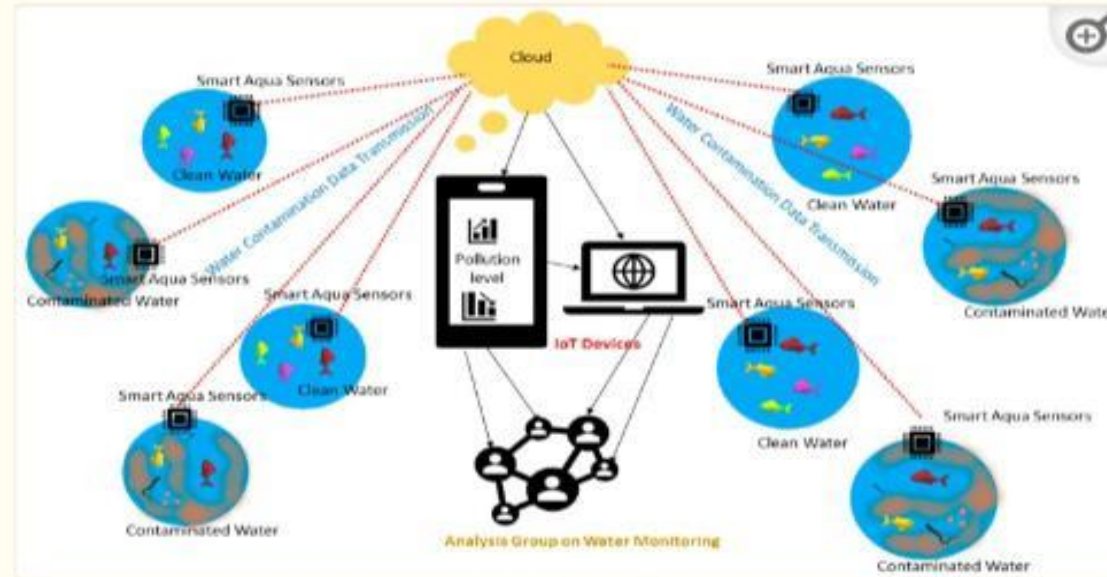
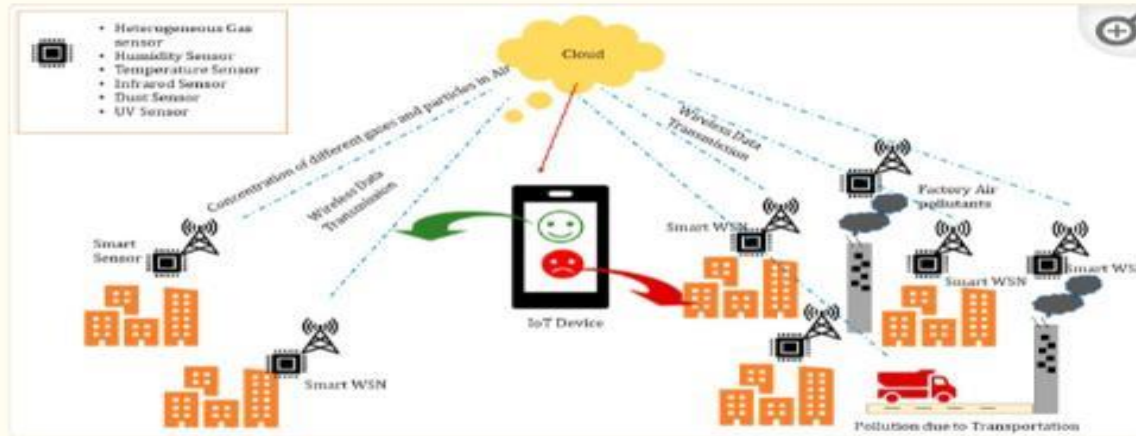


Figure 1

Smart environment monitoring (SEM) system highlighting water contamination and its monitoring using the cloud connecting internet of things (IoT's) and sensors.

One more example of a SEM system, highlighting a general purpose system with extended scope, is shown in [Figure 2](#), which shows how the system is addressing various issues related to environment monitoring, such as humidity, temperature, radiation, dust, UV signal etc. The backbone of the system is a WSN that is establishing the actual interface between IoT devices and data captured through various types of smart sensors. This is a perfect example of a “smart city” [[11,25,26](#)], using a SEM system that ensures healthy environment for its citizen.



**Figure 2**

SEM system addressing various issues in the environment using wireless sensor networks (WSNs) and IoT devices.

By focusing on agriculture, as a relevant issue for the growth of any nation, it is easy to underline how SEM can play a significant role by providing a “smart or green agriculture” [14,20,27,28], that can deal with major challenges and factors involved in sustainable growth and enhancing productivity within the agriculture sector. One such smart agriculture scenario can be seen in [Figure 3](#), where a SEM system is actually a smart agriculture monitoring system. In this case, the health of soil, moisture analysis, water contamination level, water quantity level and several other factors are very important in obtaining sustainable productivity in the agriculture sector. We can see in [Figure 3](#) that the smart agriculture monitoring system includes all such factors, controlled and monitored with the help of IoT devices, suitable sensors capturing the agricultural data, then transmitted to the cloud through a WSN.



**Figure 3**

Smart agriculture monitoring system using IoT devices and sensors.