Proposed Study for Developing Low Cost River Water Quality Monitoring System using IoT Sensors and Artificial Intelligence Algorithms for Prediction of Water Quality

Presented by : Siddig Gomha (Sudan)

Abstract:

Water is one of the primary requisites and crucial for sustaining the quality of life.

For this purpose, an Internet of Things (IoT) based water quality system capable of measuring the quality of water in real time is proposed.

The proposed solution is based on World Health Organization (WHO) defined water quality metrics, which include turbidity, temperature, dissolved oxygen level, pH

level, dissolved ammonium, potassium, nitrate and conductivity. World Health Organization (WHO) has defined safe ranges for each of the water quality parameters as shown in Table 1.

Table 1 Water parameters with safe ranges

Sr#	Parameter	Safe Range
1	pH	6.5 to 8.5
2	Turbidity	0 to 5 NTU
3	Hardness as CaCo3	500 mg/l
4	Conductance	2000 µS/cm
5	Alkalinity	500mg/l
6	Dissolved Solids	1000mg/l
7	Nitrate as NO2	<1mg/l
8	Fecal Coliform	Nil Colonies/ 100ml
9	Calcium	200mg/l

- For this purpose, a real time embedded prototype will be developed to record the water quality parameters from the water samples collected from various sources across the study area. The sensors network sends data to cloud for real time storage and processing. The processed data can be remotely monitored.

- In addition to water quality monitoring and control system, the predictive analysis of the collected data will be performed. Therefore, advanced artificial intelligence (AI) algorithms will be developed to predict water quality index (WQI) and water quality classification (WQC).

Motivation:

In fact, the consequences of polluted drinking water are so dangerous and can badly affect health, the environment, and infrastructures.

As per the United Nations (UN) report, about 1.5million people die each year because of contaminated water-driven diseases.

In developing countries, it is announced that 80% of health problems are caused by contaminated water.

Five million deaths and 2.5 billion illnesses are reported annually.

M. A. Kahlown, M. A. Tahir, and H. Rasheed, National Water Quality Monitoring Programme, Fifth Monitoring Report (2005–2006), Pakistan Council of Research in Water Resources, Islamabad, Islamabad, Pakistan, 2007, http://www.pcrwr.gov.pk/Publications/Water%20Quality%20Reports/Water%20Quality%20Monitoring%20Report%202005-06.pdf.

Objectives:

To study all available Water Quality Monitoring System.

To design Low Cost River Water Quality Monitoring System using IoT Sensor Networks.

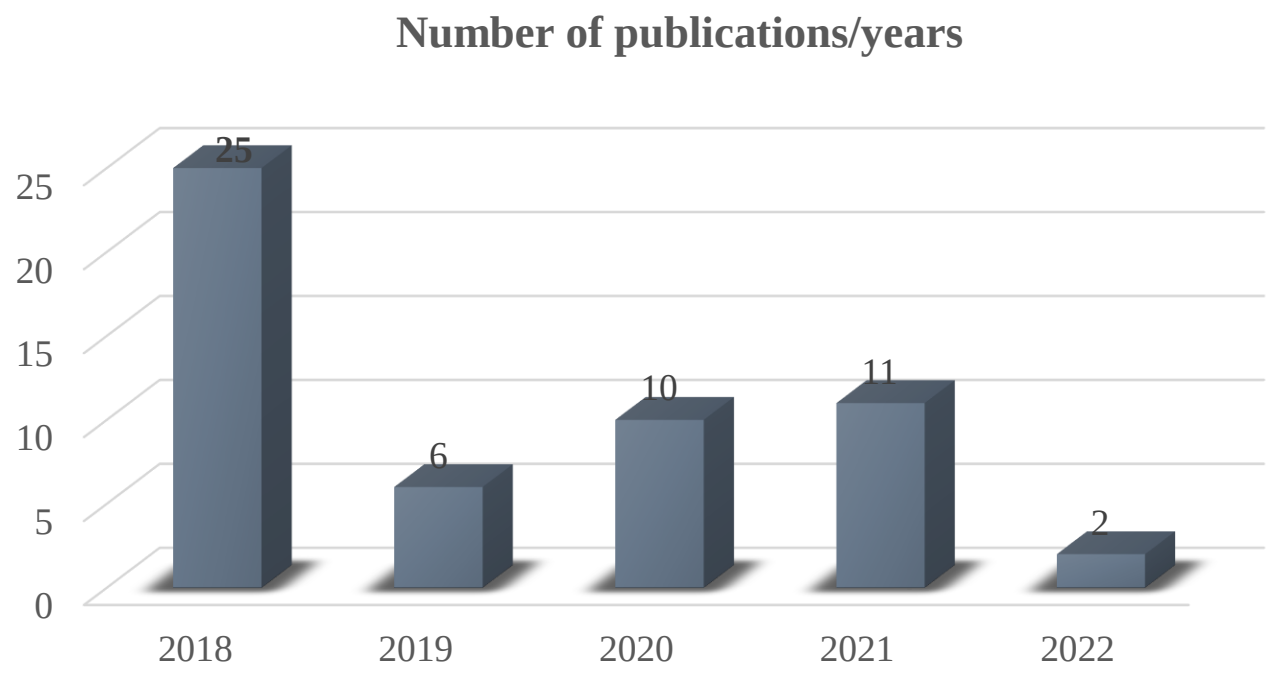
To predict water quality index (WQI) and water quality classification (WQC) using Artificial Intelligence Algorithms.

To visualize water quality parameters at realtime on a cloud server as well as mobile App.

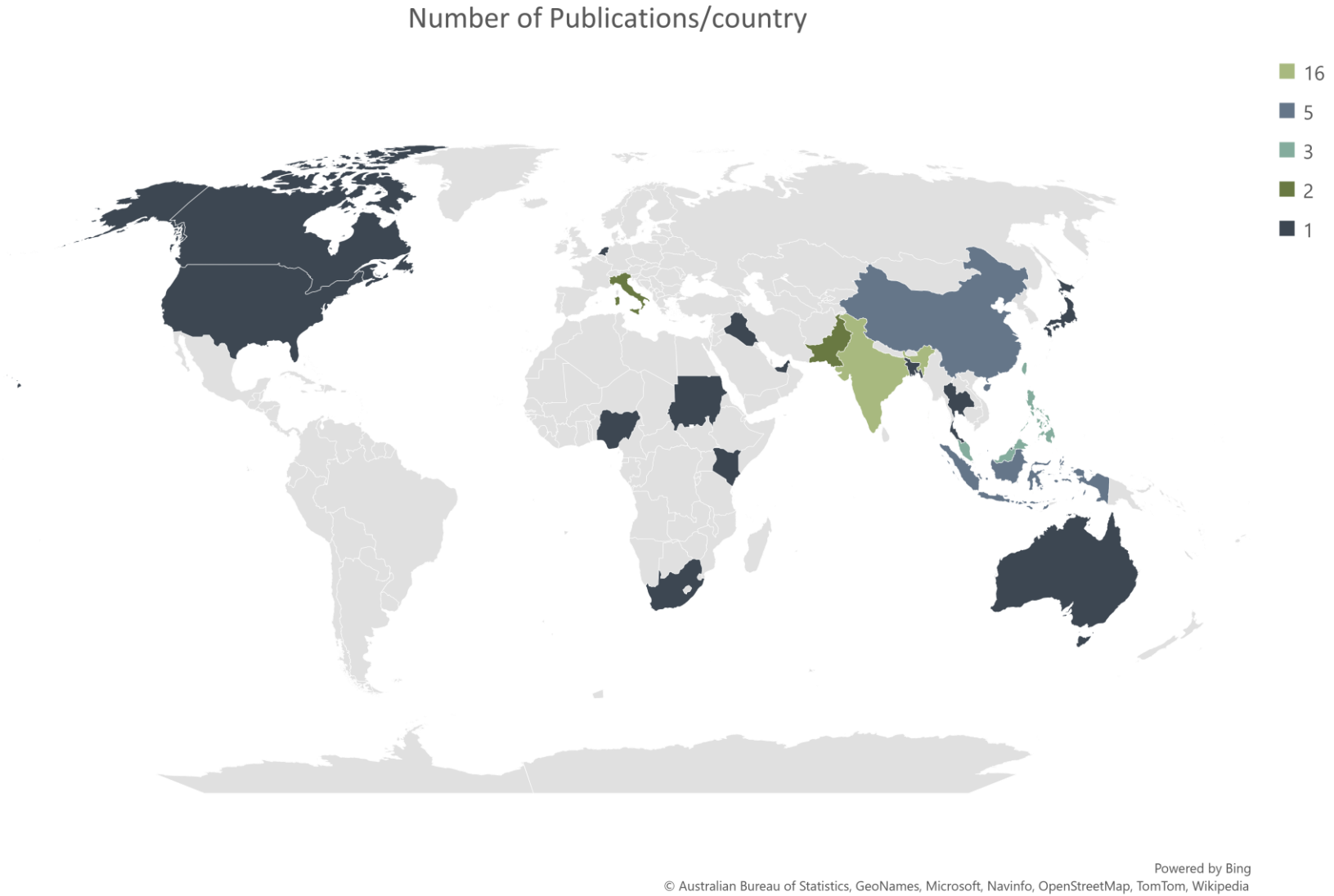
Literature Review:

Many studies have been conducted to address water quality problems.

Following slides show some statistic about recently published papers (2018 - 2022).



Literature Review:



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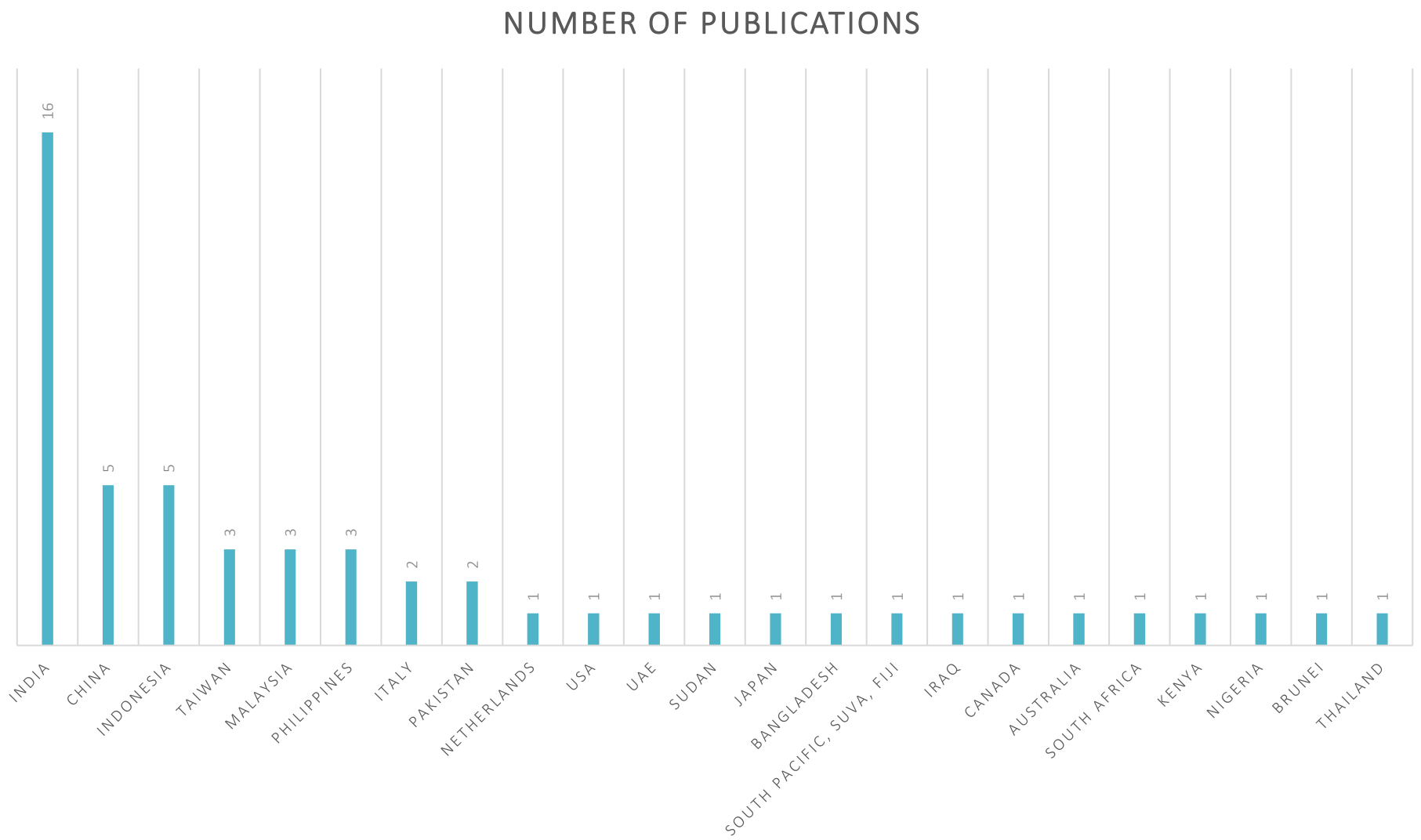

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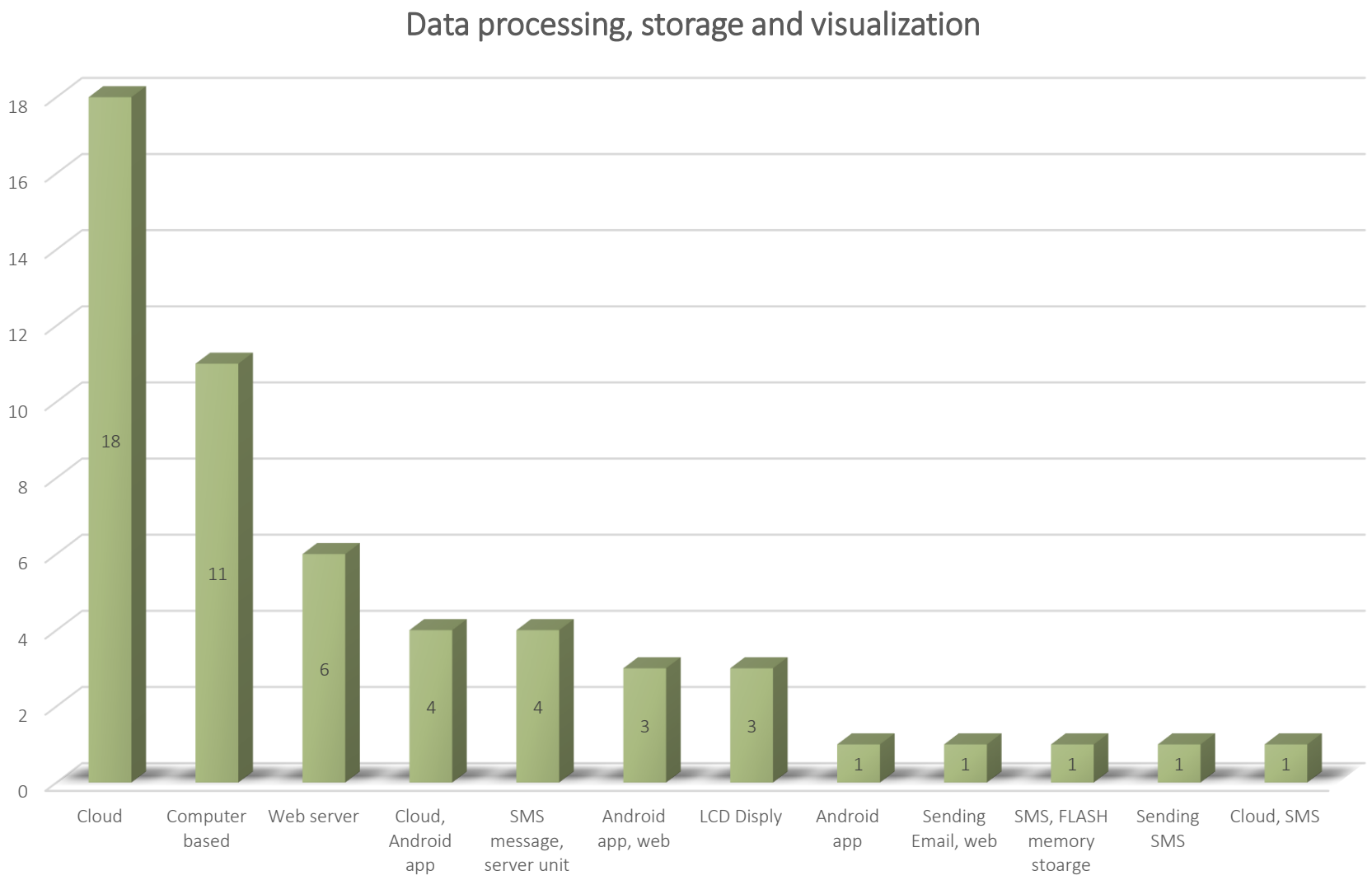
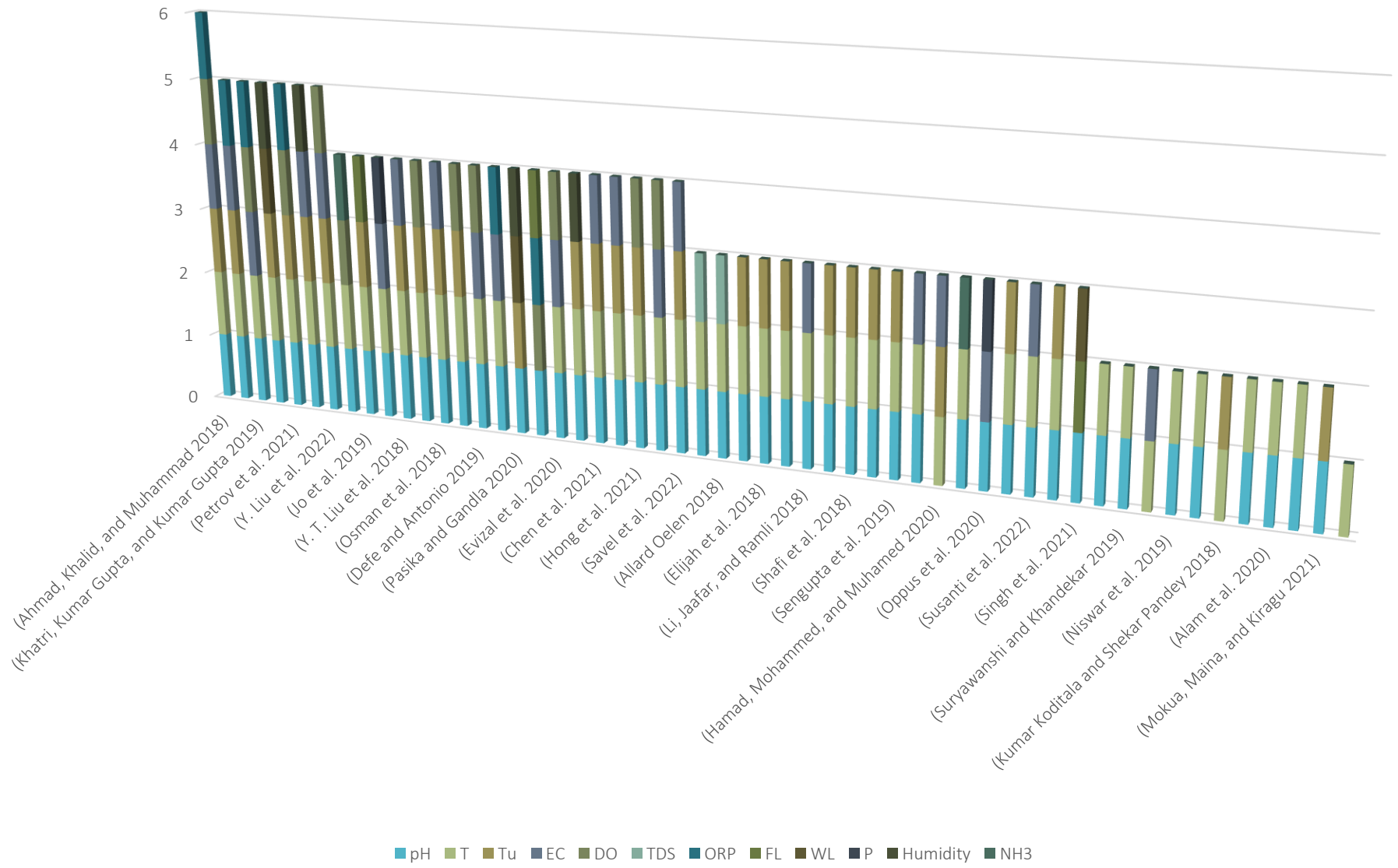


Literature Review: Types of Sensors



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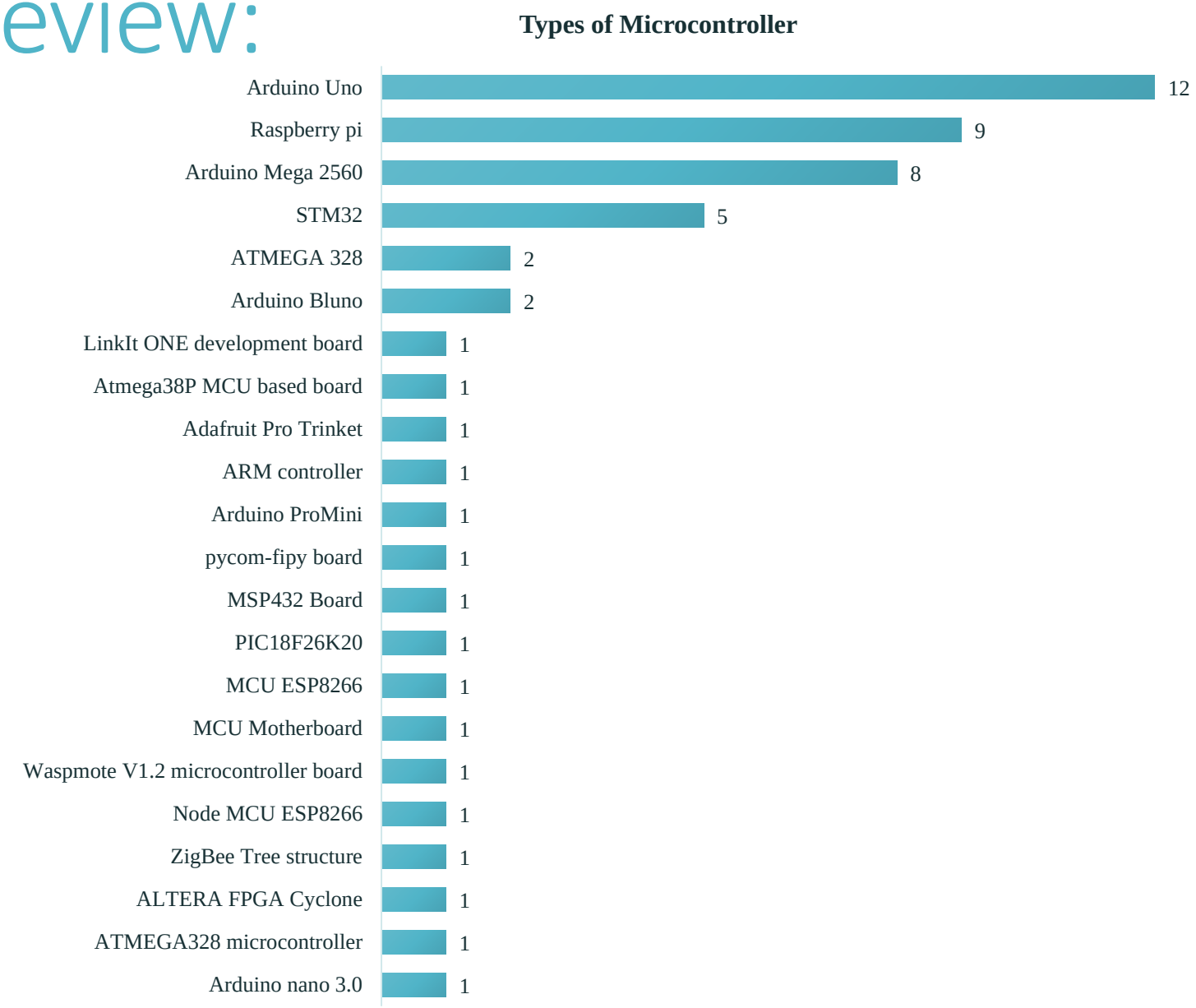

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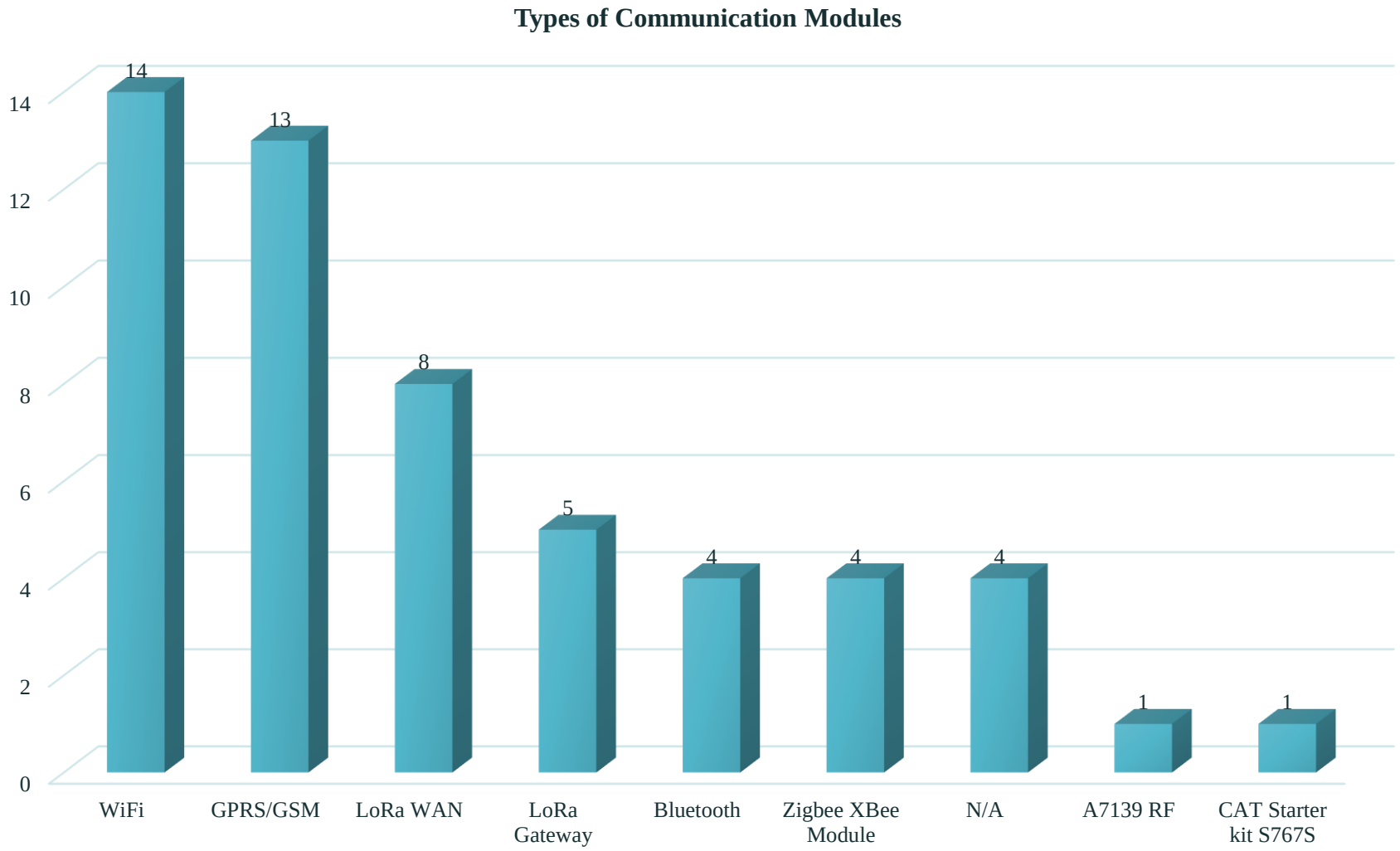

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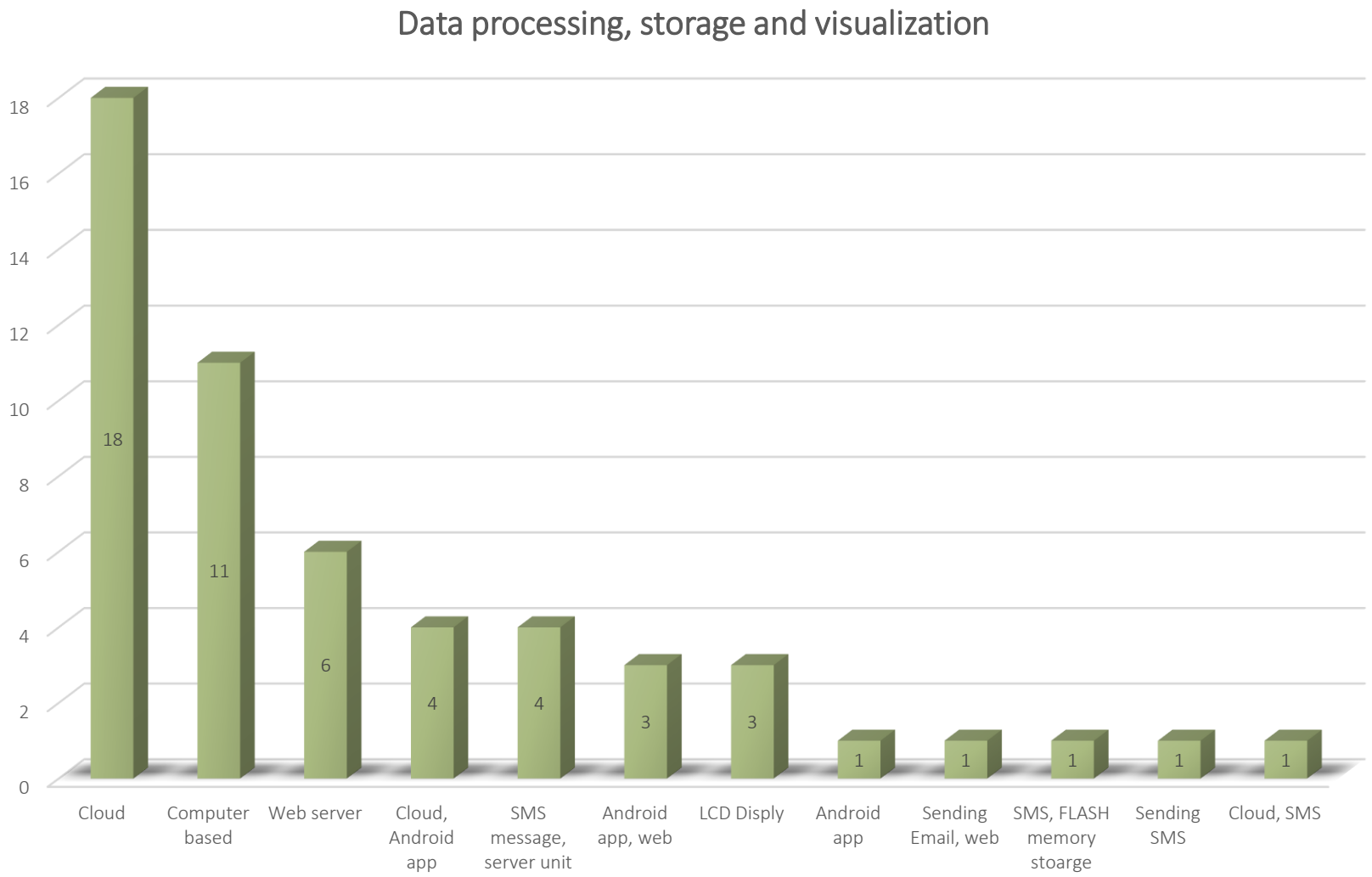

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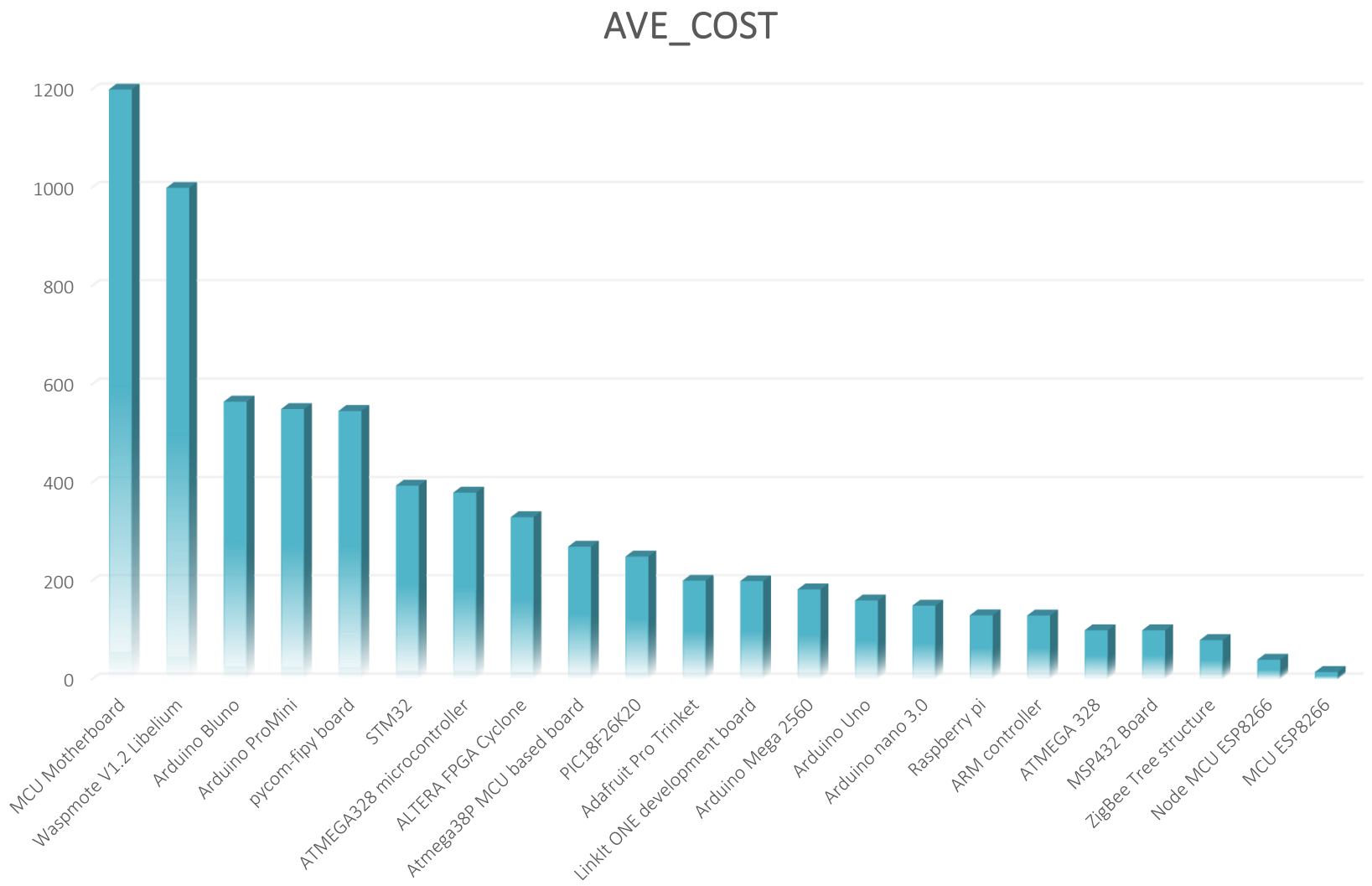

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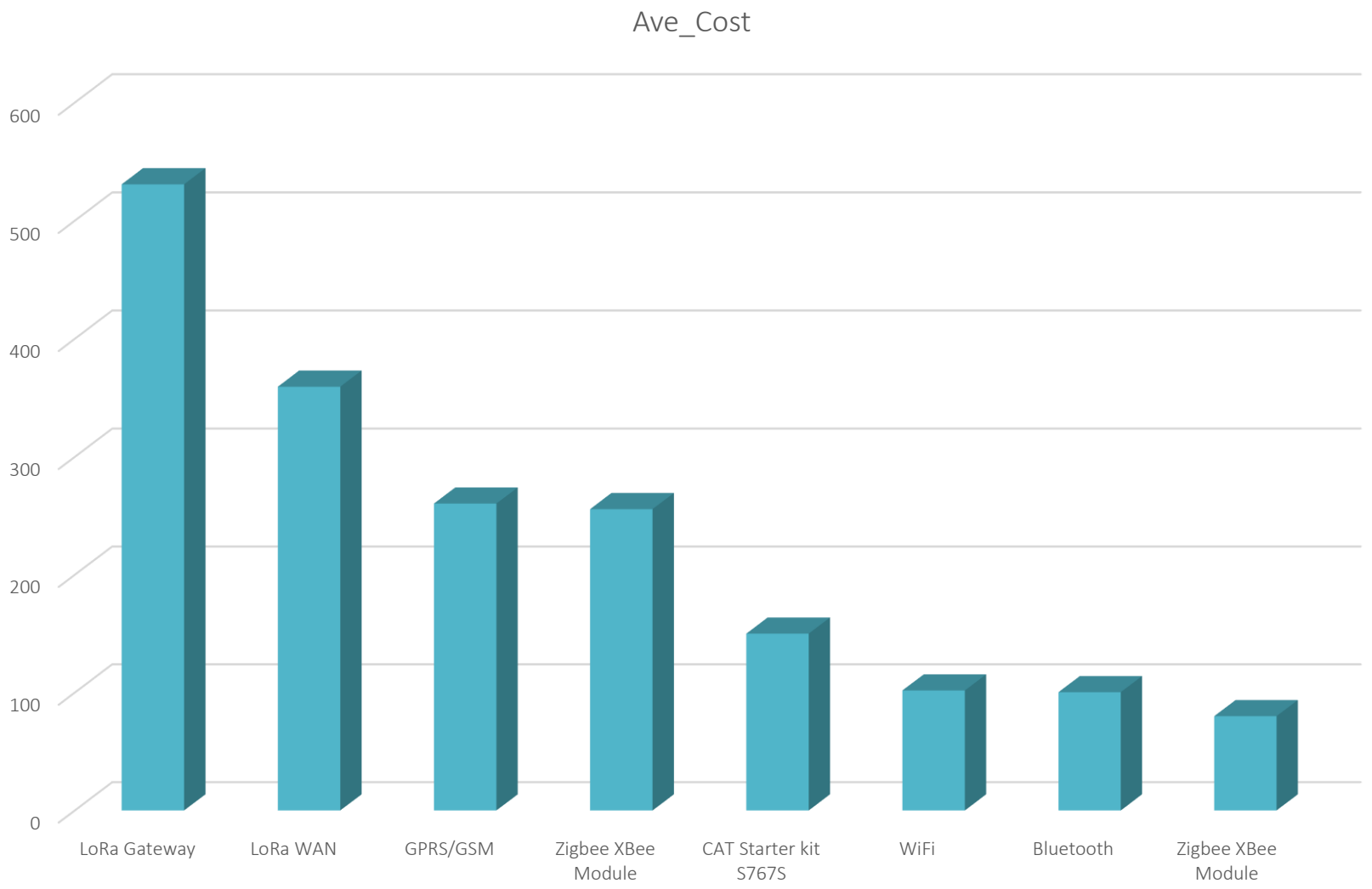
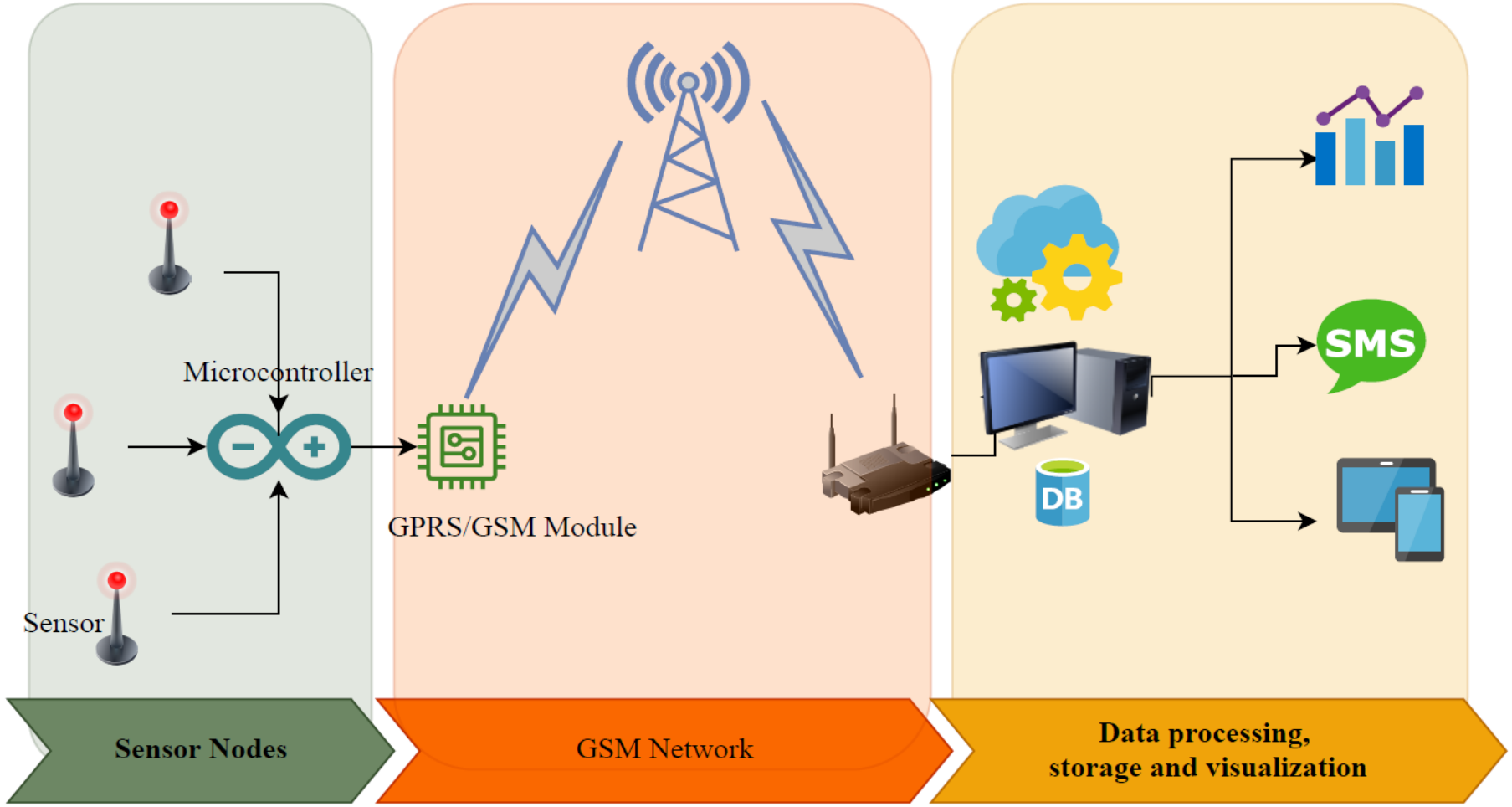


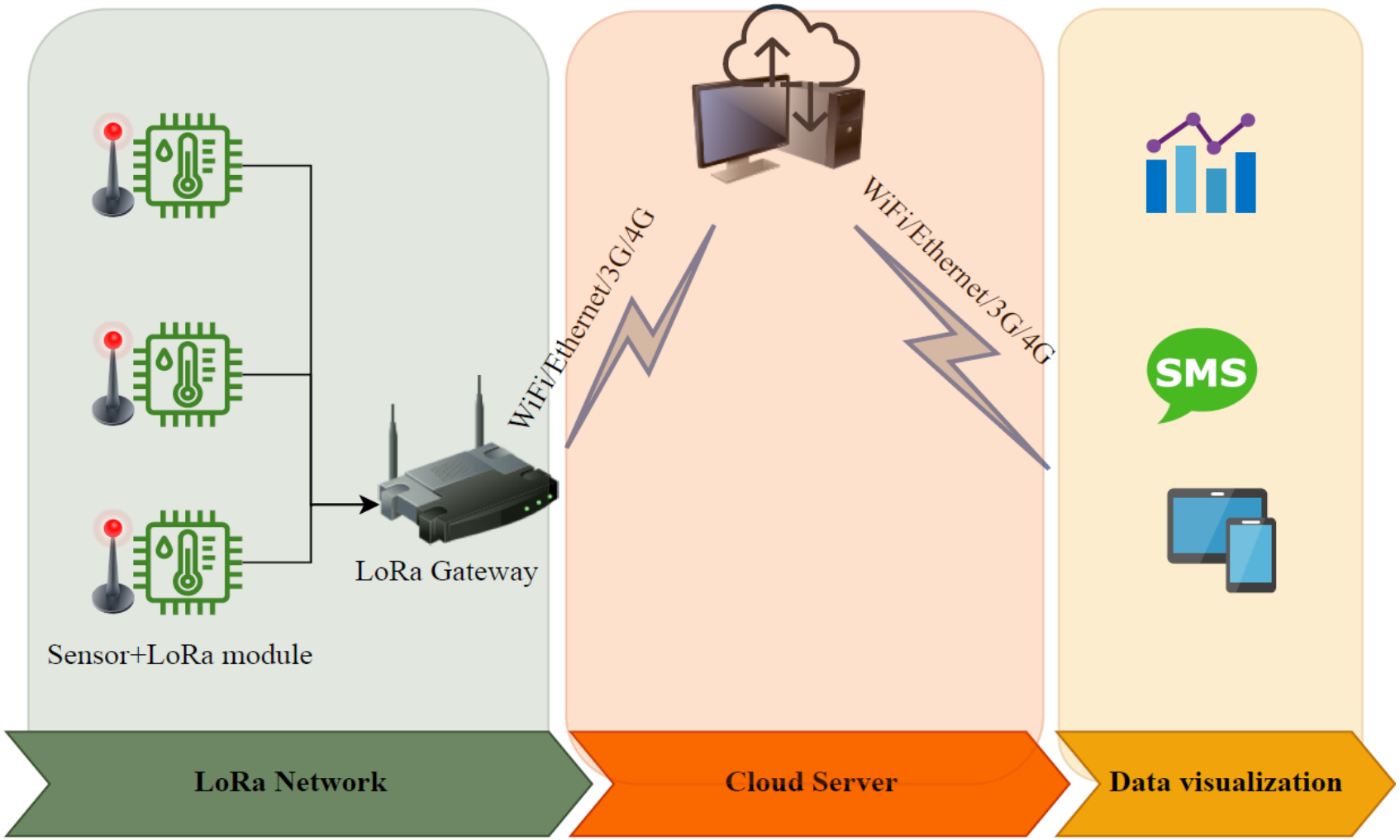
Methodology:

Wireless Sensors Network using GSM Network



Methodology:

Wireless Sensors Network using LoRa Network



Methodology:

Water quality index (WQI) prediction

For the WQI prediction, artificial neural network models, namely nonlinear autoregressive neural network (NARNET) and long short-term memory (LSTM) algorithm, will be used.

For the water quality classification (WQC) forecasting.

Three machine learning algorithms, support vector machine (SVM), K-nearest neighbor (K-NN), and Naive Bayes, will be used for the WQC forecasting.

Summery

Aim of this study is:

Reviewing all available Water Quality Monitoring System have been carried out in a few past years (2018-2022).

Design Low Cost River Water Quality Monitoring System using IoT Sensor Networks.

Predicting water quality index (WQI) and water quality classification (WQC) using Artificial Intelligence Algorithms.

Visualizing water quality parameters at real-time on a cloud server as well as mobile App.

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