Simulation of WSN System Architecture; Three-layer Cluster Architecture with Cross-Interactions Within the Upper two Layers

This wsn three-layer architecture is designed for water quality monitoring in a city. The three-layer cluster WSN architecture consists of the sensor node to coordinator layer, coordinator gateway layer and gateway to base station layer. In this basic three-layer architecture; communication exists between nodes to coordinators, from coordinators to gateways and from gateway to sink/base station. The sensor nodes do not communicate with themselves hence they are placed as star cluster topology. The coordinators are in a mesh topology same as the gateway, as they are configured to communicate coordinator to coordinator and to gateway while gateway to gateway, gateway to coordinator and gateway to base station. The mesh topology in these two layers was to help in load balancing and fault tolerance. This is depicted in figure 3.2.

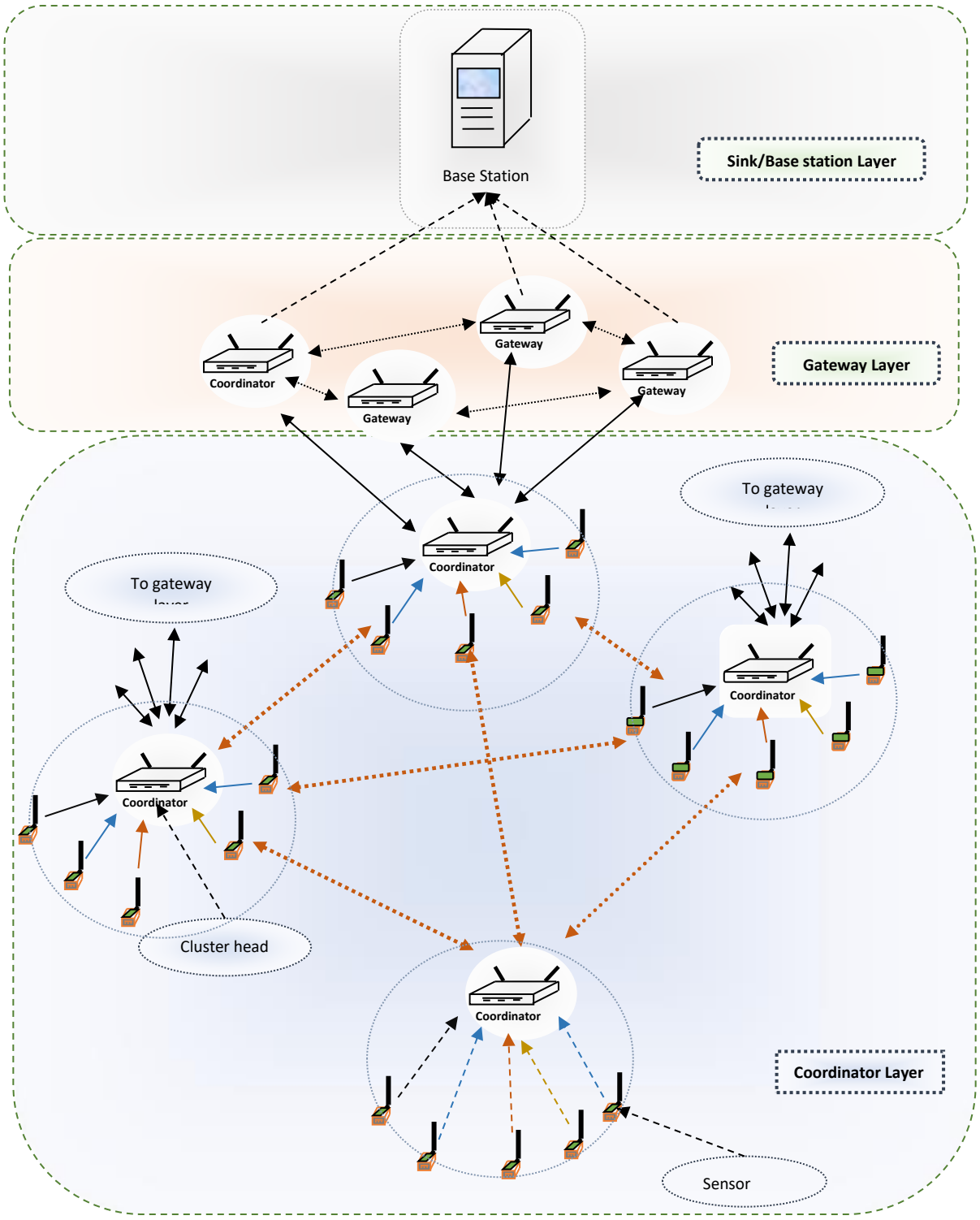


Fig. 3.2: WSN Three – layer Architecture

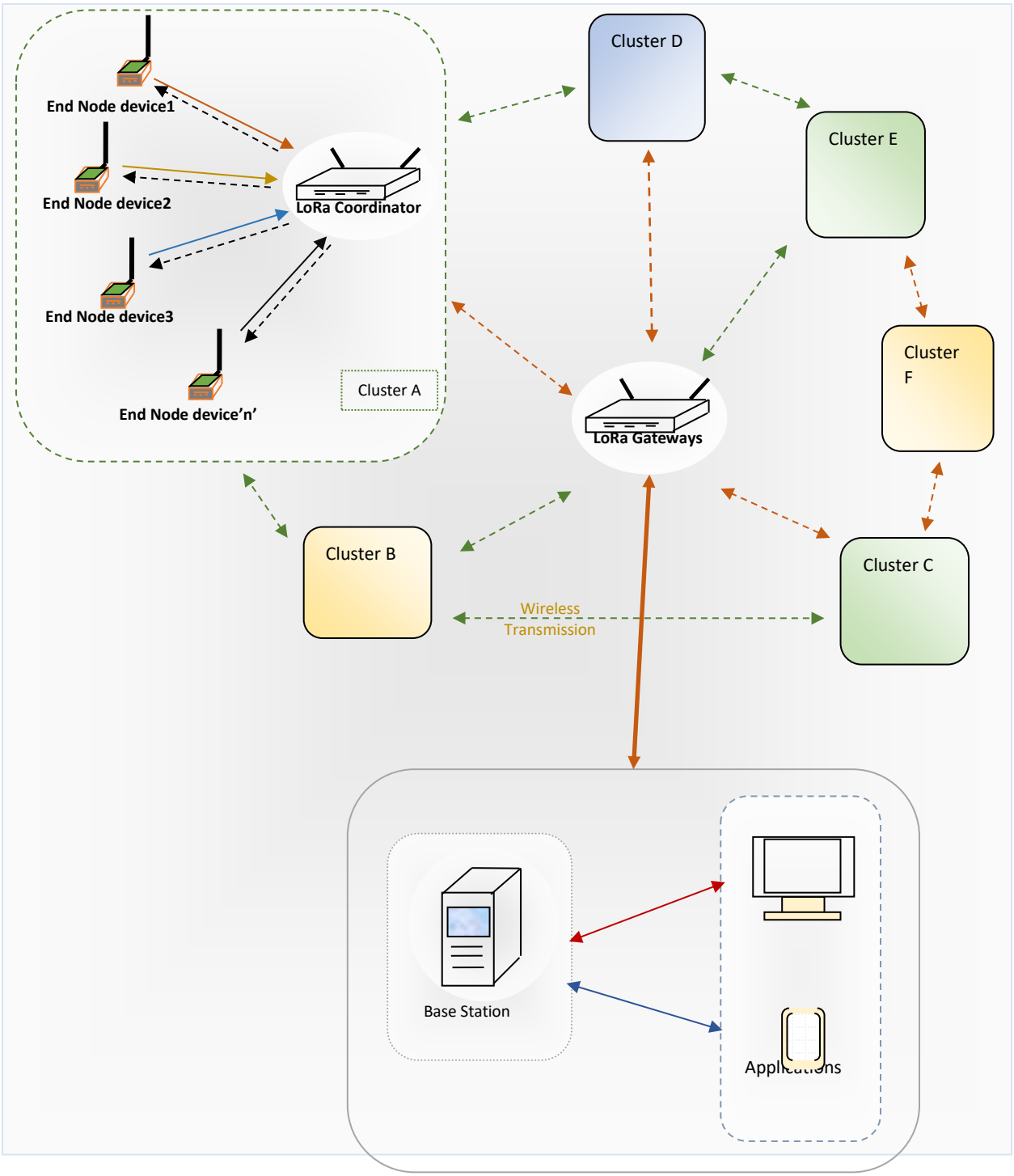


Fig. 3.3 WSN architecture

Base Station Architecture

The base station architecture is described in figure 3.7. It consists of a LoRa Gateway serving as a receiver for the wireless transmission from the central WSN

gateway. It receives the transmitted information from the field and through USB link sends the information to the computer. The computer is also depicted as the server as it will be the data storage hub to save all sensor data from the field.

The server/computer also has applications which include a server and database program for data sorting and storage and a graphic user interface GUI for displaying data from the database to monitor screen or any VDU.

The base station also has applications using GSM module for mobile communication to satisfy mobile services demand.

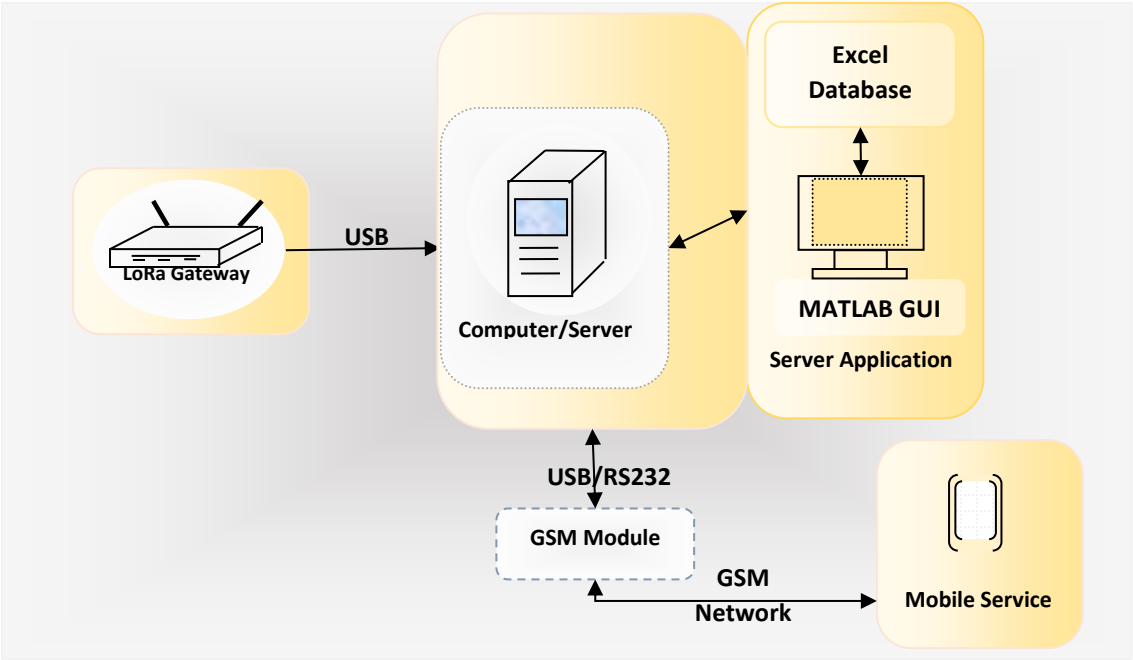
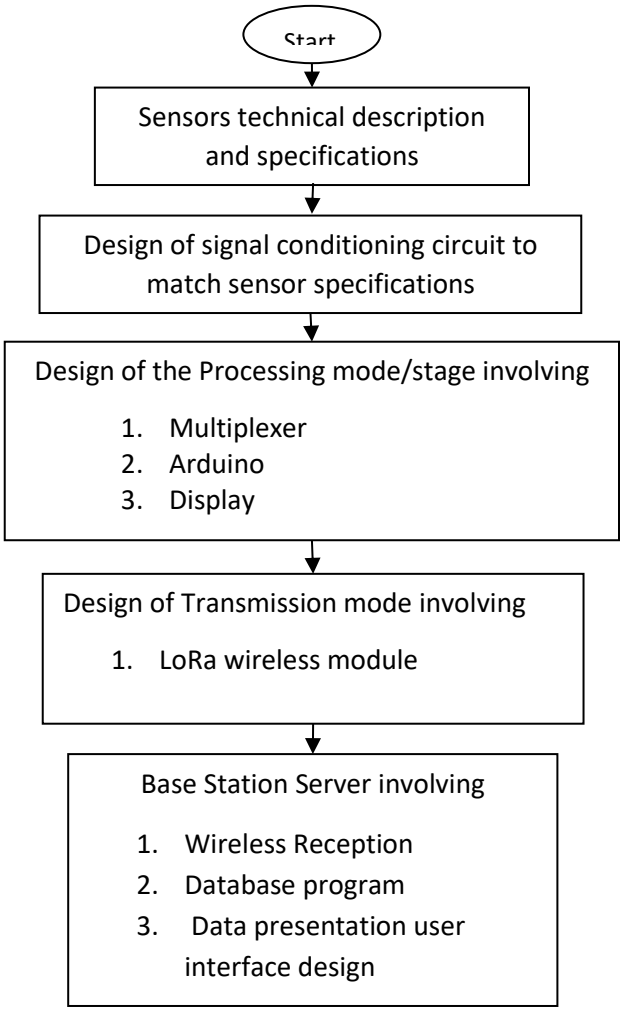


Figure 3.7 Block diagram representation of the Base Station Architecture

Site Sensor Node Architecture

The sensor nodes are also referred to as end device in this work. Figure 3.4 presents the sensor node design flowchart and figure 3.5 shows the sensor nodes or end device architecture of the system which includes the end-device Sensor Nodes

having the sensors/transducers for measuring WQ parameters with signal conditioning circuits and processing stages. It is also responsible for collecting all sensor data from a site to the coordinator of a particular region. Figure 3.4 show the design methodology flowchart for sensor node design process.



The design of the WQ tracking sensor nodes is presented fewer than three major subheads which are the sensor and signal conditioning mode, signal processing modes and wireless data transmission mode. The block diagram of figure 3.5 shows the block diagram of the full sensor nodes functional stages.

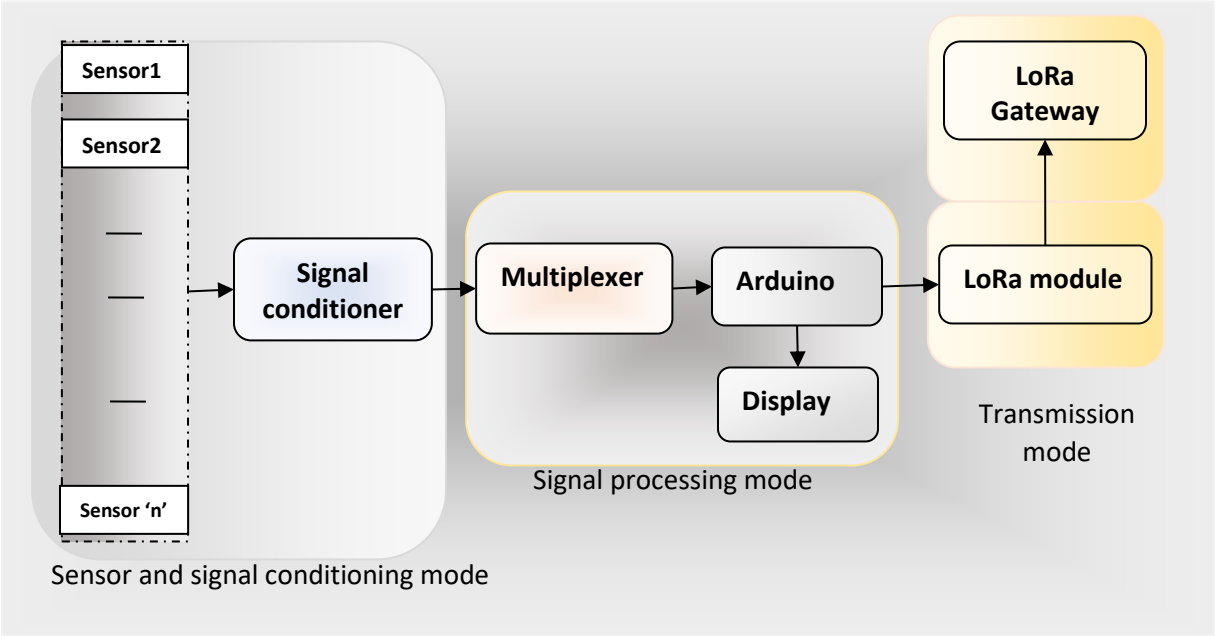
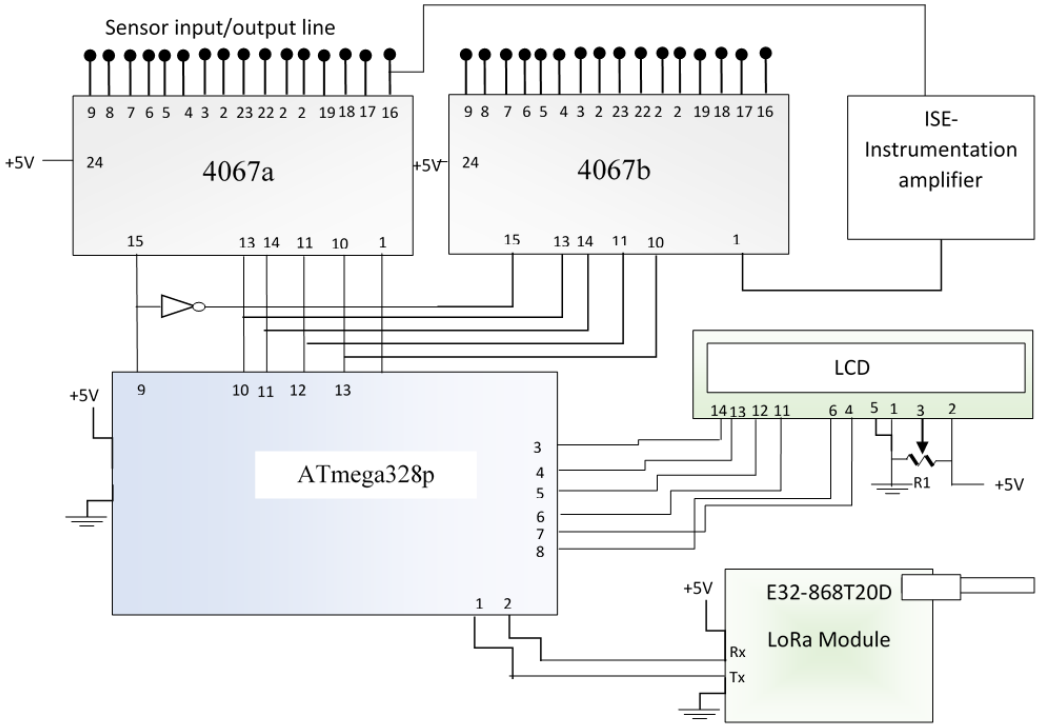


Figure 3.5 Block diagram representation of the WQ monitoring system sensor node functional blocks



S/N	Selected Critical Parameters
	Temperature
	pH
	Total dissolved Solid- TDS
	Turbidity
	Magnesium Mg
	Dissolved oxygen DO
	Chlorine Cl
	Phosphorus P
	Manganese

	Potassium K
	Cadmium Cd
	Arsenic As
	Chromium Cr
	Ecoli
	Iron Fe
	Lead Pb
	BOD
	COD

S/No.	Sensor type	IN/OUT line	Pin no.	Remarks
1	Temperature	Y0	9	Own line(OL)
2	pH and ORP	Y1	8	Switch line(SL)
3	EC and TDS	Y2	7	SL

4	Turbidity	Y3	6	OL
5				
6	Output	Z-output	1	Output
7	Output	Z-output	1	Output
8				
9				
10				

S/No.	Sensor type	IN/OUT line	Pin no.	Remarks on reference electrode
1	Calcium Ca^{2+}	Y0	9	Single junction
2	Lead Pb	Y1	8	“
3	Potassium K+	Y2	7	“
4	Cadmium Cd	Y3	6	“

5	Nitrite NO_2^-	Y4	5	“
6	Iron Fe	Y6	3	“
7	Phosphorus	Y7	2	“
8	Chromium Cr	Y8	23	Double junction
9	Chlorine Cl^-	Y9	22	“
10	Arsenic	Y10	21	“
11	Magnesium Mg^{2+}	Y11	20	“