

**Project Design Phase-II**  
**Solution Requirements (Functional & Non-functional)**

Date	03 October 2022
Team ID	PNT2022TMID35789
Project Name	Project - Smart waste management for metropolitan cities
Maximum Marks	4 Marks

**Functional Requirements:**

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Ultrasonic sonic sensor for level detection	Waste collection costs can be greatly reduced by incorporating ultrasonic sensors into trash bins. Real-time data gives the necessary feedback which reduces scheduling costs, so trash bins are only collected when full. This real-time monitoring and historic monitoring allow for better route planning and scheduling. Ultrasonic trash sensors are lower power devices that can be powered from various sources. This low operational voltage means sensors can be powered by batteries or solar panels.
FR-2	Load cell for weight	Load Cells are attached below at the bottom of Trash Bins. Weight measurement may not accurately indicate fill level of trash bin, but in case the trash bin weight reaches to the specified limit of what Garbage Truck can pick up, then waste collector vehicles can be deployed for evacuation of such trash bins. Load cells can be configured to measure weight from few kilograms to few thousand kilograms easily.
FR-3	Gps for location of bin	A small RFID microchip is fitted under the lip of each bin, which allows the truck to register each individual lift and log it directly against each bin, and its physical location.
FR-4	Gsm module for data transmission to cloud	It Provide notification to the waste authority that the recyclable waste in the smart recycle bin is full. The status of a full recycle bin will be determined by a proximity sensor. Once detected, the system will trigger the GSM module to send a signal to the waste authority, and Global Positioning System (GPS) module is used to locate the location of a recycle bin on the Google Maps. This mechanism can reduce and optimize the collection time as the recycle bin is not always full depending on the number of users and location.

### Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	<b>Usability</b>	<ul style="list-style-type: none"><li>IoT plays a crucial role in enhancing <b>smart city</b> applications through real-time monitoring and management of city processes.</li><li>IOT powered smart management solutions focus on improving the total efficiency of waste collection and recycling.</li></ul>
NFR-2	<b>Security</b>	<ul style="list-style-type: none"><li>Purchase wisely and recycle</li><li>Use a reusable bottle</li><li>Use reusable grocery bags</li><li>Avoid single use food and drink containers.</li></ul>
NFR-3	<b>Reliability</b>	<ul style="list-style-type: none"><li>All the technical aspects have been thoroughly designed keeping all the constraints in mind.</li><li>This project based on IoT gives users the freedom of changing hardware as well as software specifications as per the raising need.</li></ul>
NFR-4	<b>Performance</b>	<ul style="list-style-type: none"><li>The Smart Sensors use ultrasound technology to measure the fill levels.</li><li>Using a variety of IoT networks, the sensors send the data to Waste Management Software System.</li><li>Customers are hence provided data-driven decision making, and optimization of waste collection routes.</li></ul>
NFR-5	<b>Availability</b>	<ul style="list-style-type: none"><li>It all comes down to connecting the physical world to the digital world, such seemingly small devices powered by IoT technology can drastically improve the huge industry of waste management.</li></ul>
NFR-6	<b>Scalability</b>	<ul style="list-style-type: none"><li>Analytics data to manage collection routes and the placement of bins more effectively</li><li>Improved environment (i.e., no overflowing bins and less unpleasant odours)</li></ul>