**Technology Stack (Architecture & Stack)**

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|---|---|
| TEAM ID | PNT2022TMID25449 |
| PROJECT NAME | Project – Smart waste management system for metropolitan cities |

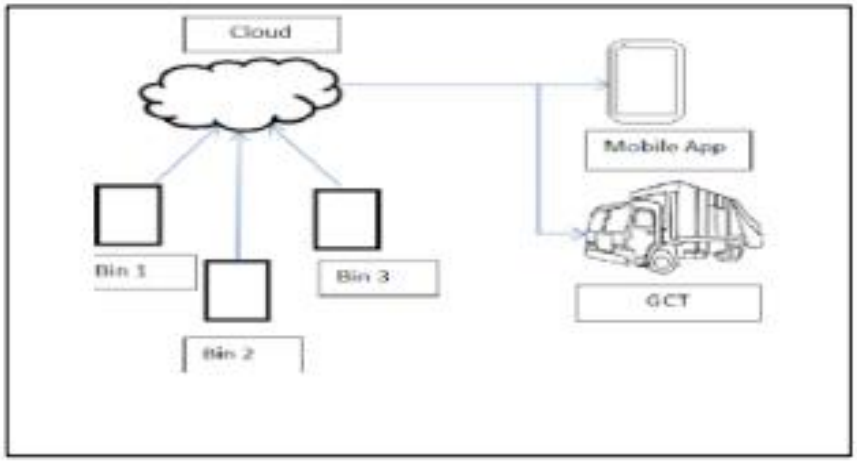


**Table-1 : Components & Technologies:**

| S.No | Component | Description | Technology |
|---|---|---|---|
| 1. | User Interface | IBM Watson IOT cloud platform | MQTT protocol |
| 2. | Application Logic-1 | Bin level status are collected by sensors | Python |
| 3. | Application Logic-2 | Data are Monitored by IOT | IBM Watson STT service |
| 4. | Application Logic-3 | Based on the level the message is send to the workers to clear the Wastes | IBM Watson Assistant |

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|---|---|---|---|
| 5. | Database | MySQL- It is database to collect the data<br>NoSQL-It is an approach to database design that enables the storage and quiring of the data outside the traditional structures found in relational database. | MySQL, NoSQL. |
| 6. | Cloud Database | It will receive the real time updates from all the garbage bins and continuously display it on the web application and also send notification to the receiver. Using mobile application. | IBM DB2, IBM Cloudant |
| 7. | File Storage | It is an easy way to back up and quick recovery to collect the old data. | IBM Block Storage or Other Storage Service or Local Filesystem |
| 8. | External API-1 | External API is exposing a projects internal resource to the outside users. | IBM Weather API, etc. |
| 9. | External API-2 | It is used to allow you to access the third party. | Aadhar API, etc. |
| 10. | Machine Learning Model | It is used to track the bin and collect the wastes in proper manner. | Python IDLE, Anaconda navigator or Jupitar. |
| 11. | Infrastructure (Server / Cloud) | Server:<br>In computing, information technology infrastructure is composed of physical and virtual resources that support the flow, storage, processing and analysis of data.<br>Cloud:<br>It includes computing power, networking, and storage, as well as an interface for users to access their virtualized resources. | Cloud - MySQL<br>server-HTTP |

**Table-2: Application Characteristics:**

| S.No | Characteristics | Description | Technology |
|---|---|---|---|
| 1. | Open-Source Frameworks | Real time monitoring system is used in bins and it will notify the level and give notification to the receiver. This system allows the user to know the fill level of each garbage bin in a locality or city at | Technology of Opensource framework |

| S.No | Characteristics | Description | Technology |
|---|---|---|---|
| | | all times, to give a cost-effective and time-saving route to the truck drivers. | |
| 2. | Security Implementations | Data security is implemented who's allowed to use and Firewalls provide protection against outside cyber attackers by shielding your computer or network from malicious or unnecessary network traffic. These are all implemented for our security | Data security, Firewall |
| 3. | Scalable Architecture | If use these types it will reduce the bins and time saving purpose. It leads to smart city in future because we monitor 24*7. cost wise is higher. | Technology used |
| 4. | Availability | Waste management reduces the effect of waste on the environment, health, and so on. It can also help reuse or recycle resources, such as; paper, cans, glass, and so on. It leads to smart city. | IOT, Mobile application |
| 5. | Performance | IoT and cloud computing technology provide high-tech sensors and enable waste management companies to optimize routes. To help minimize unnecessary trips to and from landfills, companies and communities can install waste level sensors in bins or dumpsters of any size. These devices collect and store data on fill levels, allowing collection services to predict how often bins need to be emptied. | IOT,RFID |