AN IOT BASED SMART WASTE MANAGEMENT SYSTEM USING LORA AND TENSORFLOW DEEP LEARNING MODEL

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Introduction:

Internet of things (IoT) is a communication paradigm that envisions a future paradigm where everyday life objects will be equipped with a microcontroller and some form of communication protocol [1]. One well-known product of IoT is the smart city, which can be defined as a city with smart technology, smart people, and smart collaboration. IoT shall transparently and seamlessly incorporate a large number of heterogeneous end systems while providing open access to select subsets of data for the development of a plethora of digital services [3]. One major topic within the smart city is smart waste management. When it comes to waste management systems, the communication distance between the waste collection center and the waste collection point is a major factor in determining the system's effectiveness. Waste management is a costly operation as it takes up a great deal of resources and labor. Efforts have been taken by the authorities to improve waste management systems by setting up the recyclable bin and launching the 3Rs campaign (recycle, reuse and reduce).

Objectives:

1. Plastic Detection
2. Paper Detection
3. Metal Detection

Methodology:

There are two sections, namely- transmitter section, receiver section. In transmitter section PIcamera will detect the type of wastage for segregation and sends the particular data to the Arduino. Then the motor starts and open the lid of the garbage box. Ultrasonic sensor will monitor the garbage level in the garbage box and sends the data to the arduino. Then the same data is sent to the lora tx. In receiver section the arduino will receive the data sent from the lora rx and sends to the wifi module to send the pop-up message in the application for the collection of garbage from the bin.

Block diagram:

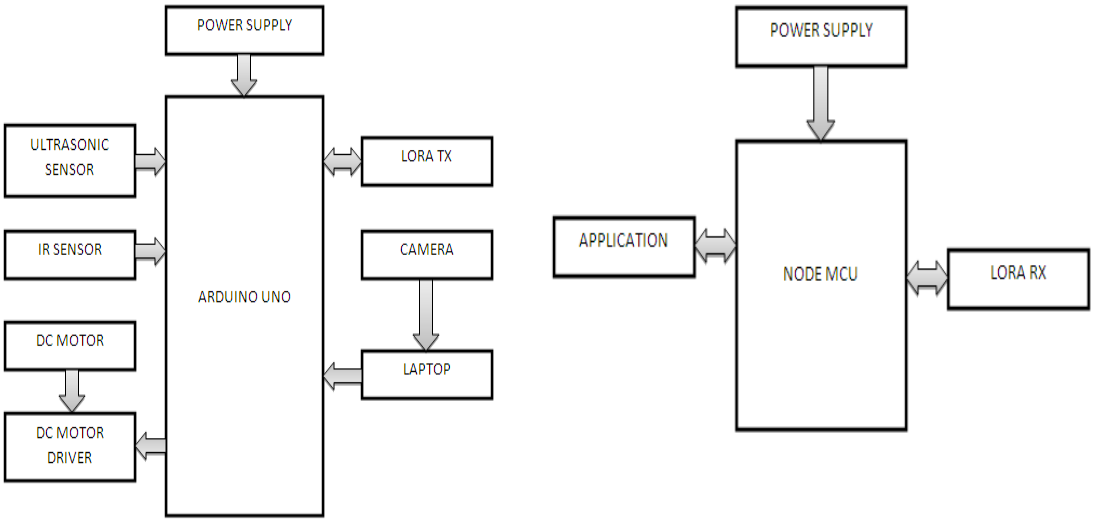

Fig. 1 : Block diagram of Smart Waste Management System

Hardware requirement:

- DC motor
- Battery
- Picamera
- GPS
- Ultrasonicsensor
- Arduino
- Lora
- Wifimodule(NodeMCU)

Software requirements:

- Python
- PyCharm
- Opencv
- Tensorflow
- Arduinoide
- Blynk
- Raspbianos

Result:

The waste detection model that is generated, obtained an average precision of 88.4%. The precision for each type of waste detection is to be improved by increasing the number of sample data images. Waste detection running on the Arduino uno with camera module captures at a rate of around 0.75 frames per second. Training of the waste detection model is done using Anaconda Distribution, a generalpurpose Python notebook used to perform tasks such as machine learning, training the neural network, data visualization, predictive analytics, and bias mitigation. Transfer learning is performed on a pre-trained model, SSDMobileNetV2 by retraining the model with our own sets of waste images.

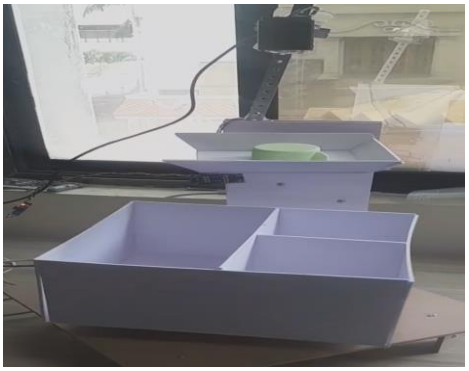

Fig 2 : image of smart waste management system model

Fig 3 : Image of plastic

Fig 4 : image of metal

Fig 5 : image of paper

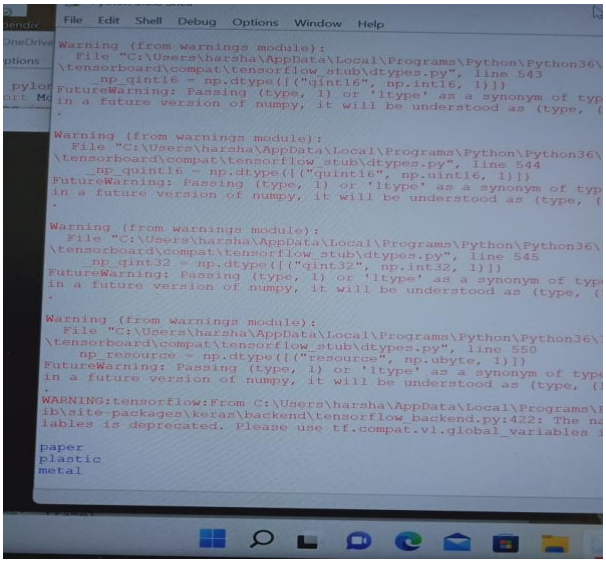

Fig 6 :Detection of plastic, paper, metal

Conclusion:

A smart waste management system will be implemented using sensors to monitor the status of the bin, LoRa communication protocol for low power and long-range data transmission(up to >10km), and TensorFlow-based object detection to perform waste identification and classification.