Introduction - Public transport systems have a major role in transportation of people throughout the length and breadth of all cities. These systems not only decrease the volume of vehicle traffic of private vehicles but help all sections of society commute with ease. The major public transport systems include city buses, trams, local trains, transit systems (metro, underground subways). Buses or coaches have always dominated all the cities due to their convenience and frequency with which they transport. Buses can travel into all corners of a city and is much more economical to operate for the local governing bodies. No specific tracks or paths are required to operate them and bus stations are easier to build. The problem with the public transport systems are they need to operate even when there are no passengers to alight them. Almost all the public transport systems operate on timings. They have specific fixtures or timetable on which they run. With this system there is wastage of fuel and increase in the traffic.

The Internet of Things refers to the ever-growing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems. The role of IoT in this project is to connect various bus stations and metro stations to the internet. This will provide immediate and real time data for monitoring as well as control. IoT will also play a major role in connecting users, drivers and the corporation.

Digital image processing is the use of computer algorithms to perform image processing on digital images. The first step of the detection process is to detect an object which is in motion. Object detection could be performed using background subtraction, optical flow and spatio-temporal filtering techniques. Once detected, an object could be classified as a human being using shape-based, texture-based or motion-based features.

Objectives –

Public transport systems are mainly used because of their resource saving as well as pollution reducing factors. Many times due to shortage of passengers in the respective systems, they run for a very few passengers. This causes wastage of fuel and resources worse than private means of transport. Our focus is only public transport vehicles like buses and metro trains. The current system utilizes time based transport triggering, the buses and trains start from their first station at prescribed intervals of time as per their schedule even if there are no people in the upcoming stations. This is a loss both to the system as well as to the nature. Hence our solution will effectively solve the demerits of this current system.
Methodology –

We utilize a raspberry pi 3+ mini-computer with Raspbian Operating System installed in it. We attach a camera module to the raspberry pi so that it can continuously record the video footage of the bus station. We place this Raspberry pi with a camera module and battery to power the computer at a strategic point at the bus station so it continuously gets the video data. We use image processing technique to process the video frames and detect the number of humans in each station. We use OpenCV platform with programming in Python to implement the image processing algorithm for human detection.

To charge the Raspberry pi we can use a DC power supply from an adaptor which is in turn powered by AC supply used to power Bus terminal lights. We can also use a solar panel to charge the batteries. This setup is initiated at all bus stations. We also need to provide suitable internet connection to the Raspberry pi by means of Wi-Fi or Ethernet as it possesses them in-built. The number of people present in each station is sent to a web server which contains tables of various stations. We use a MySQL server platform to store our station data. We create a simple webpage using HTML to display the crowd in all the stations.

An ESP8266 nodeMCU with a LCD screen will be fitted in the dashboard of the bus. NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

The nodemcu keeps on sending URL/WEB requests to the server to start the bus trip. As soon as the crowd in most of the stations reaches the threshold, the server sends a REPLY to the request to the NODEMCU and to a mobile application which notify the driver to start the trip and also provide route of the trip using MAPS API. The native application will be developed for Android OS Cell phones using Android studio and MIT App Inventor.

We will also use PHP as a server side scripting language to send and receive requests from the Nodemcus. To program the Nodemcu we use Arduino IDE with board specified as nodemcu 1.0 and with a baud rate of 115200 bits per second.

The server side scripting programming logic is also responsible for re-routing buses to other stations which do not belong to their route but have crowd in them and the overall route crowd is not enough for another bus to start the trip.

The proposed system is a real-time system which works in the following way,

• Cameras will be placed at each bus station and metro station strategically so that it can focus on all the passengers waiting for the buses and trains.
A continuous video footage will be taken from all the cameras and the video is converted into single frame by the processor placed along with it,

The frames are then processed using image processing algorithms and using machine learning principles, humans are detected from the image frame and their count is obtained continuously. The count value is updated to our server from all the stations using data network via the processor.

Algorithms in the server measure the number of people in all the stations of the travel route and intimate the driver to start the journey as well re-route details for nearby stations via a mobile application.

**Results & Conclusion –**

- Detection of number of people in a bus station.
- Transmission of the crowd number to the server.
- Triggering the bus driver to start his route when there are threshold number of people in a minimum set number of stations or have spent a threshold amount of time at the bus stations.
- User end Applications with Bus Details, Route Details, Bus request option, & Live Bus Tracking option.

**Scope for Future Work**

- Effective utilization of fuel and resources.
- More transport facilities can be made available is there is more crowd traffic in the route.
- Re-routing the travelling bus to another station which is not in its route and has large crowd but the total crowd in most of the stations is not sufficient for another bus to start the trip using Machine Learning.