Train Bus System: Future of the City-Optimized Solution of Road Congestion & Efficient Transportation Mode

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Abstract: **Due to globalization the use of vehicles is highly increased. As we know now days every country is facing problem of traffic congestion or we can say traffic jam. Tom-Tom is Dutch Company which manufactures traffic and mapping products. As many as 390 cities, in 48 countries and six continents, were surveyed by Tom Tom. According to Tom Tom index top 5 countries are Mexico, Thailand, Indonesia, China and Romania facing a traffic congestion problem. In India there are some cities like Mumbai, Pune, Kolkata, Bangalore and Delhi also dealing with same traffic congestion problems. Main causes of traffic are increasing use of vehicles, globalization and industrialization, poor highway infrastructure, inadequate knowledge of traffic rules and obstacles in the road like accidents, road work, double parking, road narrowing down etc. Increasing demand of transportation causes the air and noise pollution which affects human beings and also nature. Researchers are trying to develop the ideal mode of transportation not only to decrease the emission of green house gases but also at the same time to meet the demand of transportation. In this paper we are going to introduce Train Bus System Future of the City. The main concept comes from China at Beijing International High-Tech Expo in May 2010. Chinese Developers already designed developed and presented prototype. They passed the first stage demonstration of Train Bus System in year 2016.**

Index Terms: **Train Bus, Double Decker Elevated Platform Bus, Microcontroller, IR Sensors, Ultrasonic Sensors, DC Motor Driver, LCD, RFID Tag, RFID Reader, Buzzer, Stability.**

I. INTRODUCTION

The original concept of Train Bus System (TBS) was first proposed by Two American architects, Lester Walker and Craig Hodgetts as a Public Transport concept known as "Bos-Wash Landliner. Due to increasing use of vehicles causing traffic congestion and air pollution which affects nature and humans. Later another design was developed by Chinese Future Parking Company "Shenzhen Hashi" known by 3D Express Bus. Some other names given to this system are Straddling Bus, Land Air Bus System, and Double Decker Bus, 3D Bus, Automated Guided Bus or Tunnel Bus. First well designed prototype model was showed in Dec 2016, Beijing International High Tech Expo.

In China and also in India there are four modes of public transport: Normal Buses, Bus Rapid Transit (BRT), Light Train (Road Tram/Monorail/Metro), Subway. They have some advantages and some disadvantages subway costs a lot and takes a long time to build; BRT takes up road spaces and produces noise pollution as well as air pollution. Subway will take 3 years for building 40-km. There is a need to develop environmental- friendly public transportation. Train Bus System provides a solution for this problem. The highlight innovation of straddling bus is that it runs above the cars and under overpass which saves the extra road/rail track and gives rise to efficiency and high capacity.

II. CONSTRUCTION

Train Bus System combines the advantages of BRT; it is also a substitution for BRT and Subway in the future. The majority vehicles on the roads are cars, the shortest vehicles are also cars. This bus is about 4.5m above the road. The TBS has two levels, first is for passengers and second is for vehicles. The bus's lower body is hollow like tunnel shape which allows the passing of the other vehicles beneath from it. Overall height of bus is 4 m to 4.5 m (13.1234ft to 14.7638ft.). Vehicle height less than 2m to 2.5m (6.56168ft to 8.2021ft) easily passes beneath the bus.

There are two parts of constructing the Straddling or TBS. One is remodeling the already constructed roads and other is building station platforms for passengers. We can remodel the roads by two ways, first we can go with laying rails on both sides of car lane, which can save up to 30% energy; or on both side of road we can paint 2 white lines and can develop auto pilot technology in the bus. Many industries are using this type of technology called Automated Guided Vehicles (AGV) in industry to load /Unload the material. Vehicles which senses and follows path by using markers, wires, magnet, vision and navigation system is called as AGV. Train Bus System completely powered by municipal electricity and solar energy system. While running on road it can use electricity with the help of electrical overhead lines or any other device. It has capacity to store the electricity power. Another alternative way is Photovoltaic panels or we can say solar panels which are mounted on roof of the Straddling bus. But in rainy season due to lack of sunrays there is problem with solar energy.

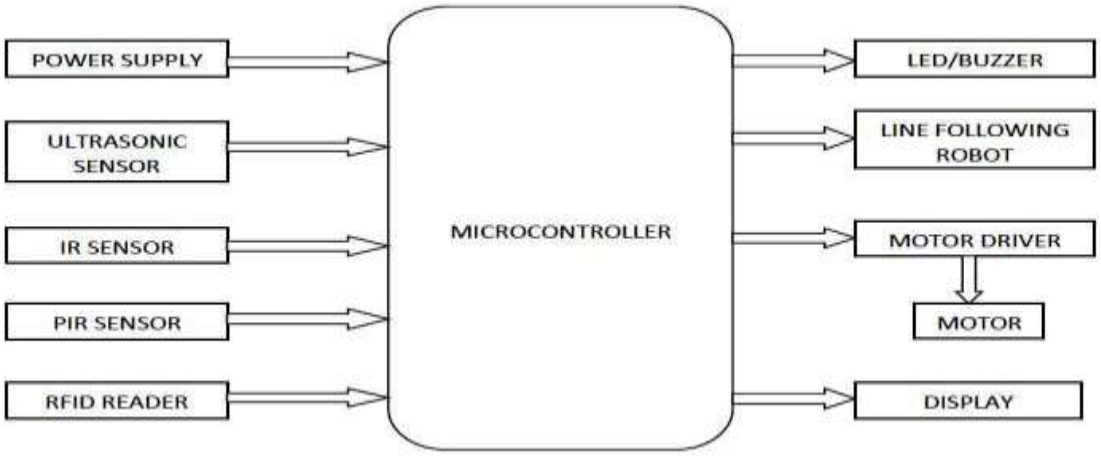

Fig1. Block diagram of Train Bus System

III. WORKING

Straddling bus is designed and developed by considering not only traffic congestion but also pollution. It can be worked on Municipal Electricity or Solar Energy. When it uses electricity the setting is called "Relay Direct Current Electrification." Continuously running bus takes power either from Conductor running along the track or from overhead lines. The Straddling bus itself is electrical conductor in that two rails built up on top to allow the charging post to run along with the train bus, the next charging post will be on the rails until the earlier ones leaves, that is why we call it Relay Charging. Here we can use powerful capacitor for charge, discharge and store electricity quickly. The power bus stores during the stop can support the bus till the next stop where another round of charging takes place, achieving zero toxic gas throughout the process.

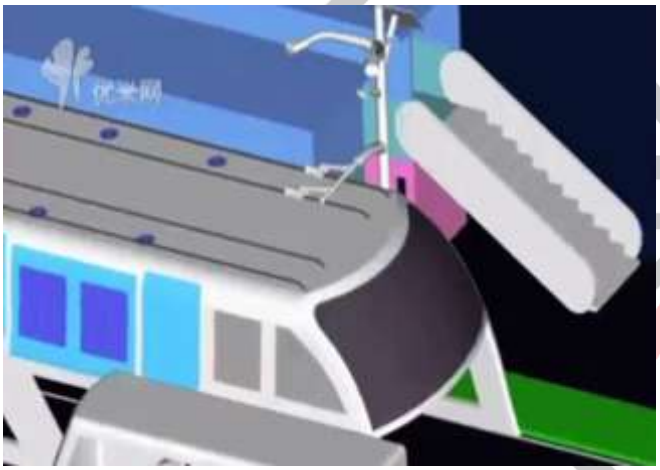

Fig2. Relay Direct Current Electrification

Fig3. Solar Photovoltaic Panels Method

Solar energy is another Non Conventional Source of Energy (Renewable), which is non-polluting and inexhaustible. Photovoltaic panels or cells are mounted on roof of the bus. By using electricity or solar energy bus follows the fixed path. In this concept we use microcontroller as a CPU which is from ARM family. The application of IR sensor is when bus comes at the station it will stop the bus automatically. Conveyor or elevators are used here for passengers so that they can easily go inside and outside in the bus. Buzzer alarm is used for passengers alert. The microcontroller, on which motor driver IC is interfaced, controls the movement of the bus. At the station platform there are LCD screens for the passengers. The LCD screen shows status of the bus, expected arrival time, current station, next station, number of passengers onboard and total number of stations with city maps etc.

In this technology of bus RFID automatic ticket collecting system is introduced. Card is sensed twice at the time of entry and exit of the passengers. It is used to gather information from which station passenger boards the bus and in which station exits. This information is helping how much distance is travelled by the passenger with the amount. The amount can be directly deducted from the bank card.

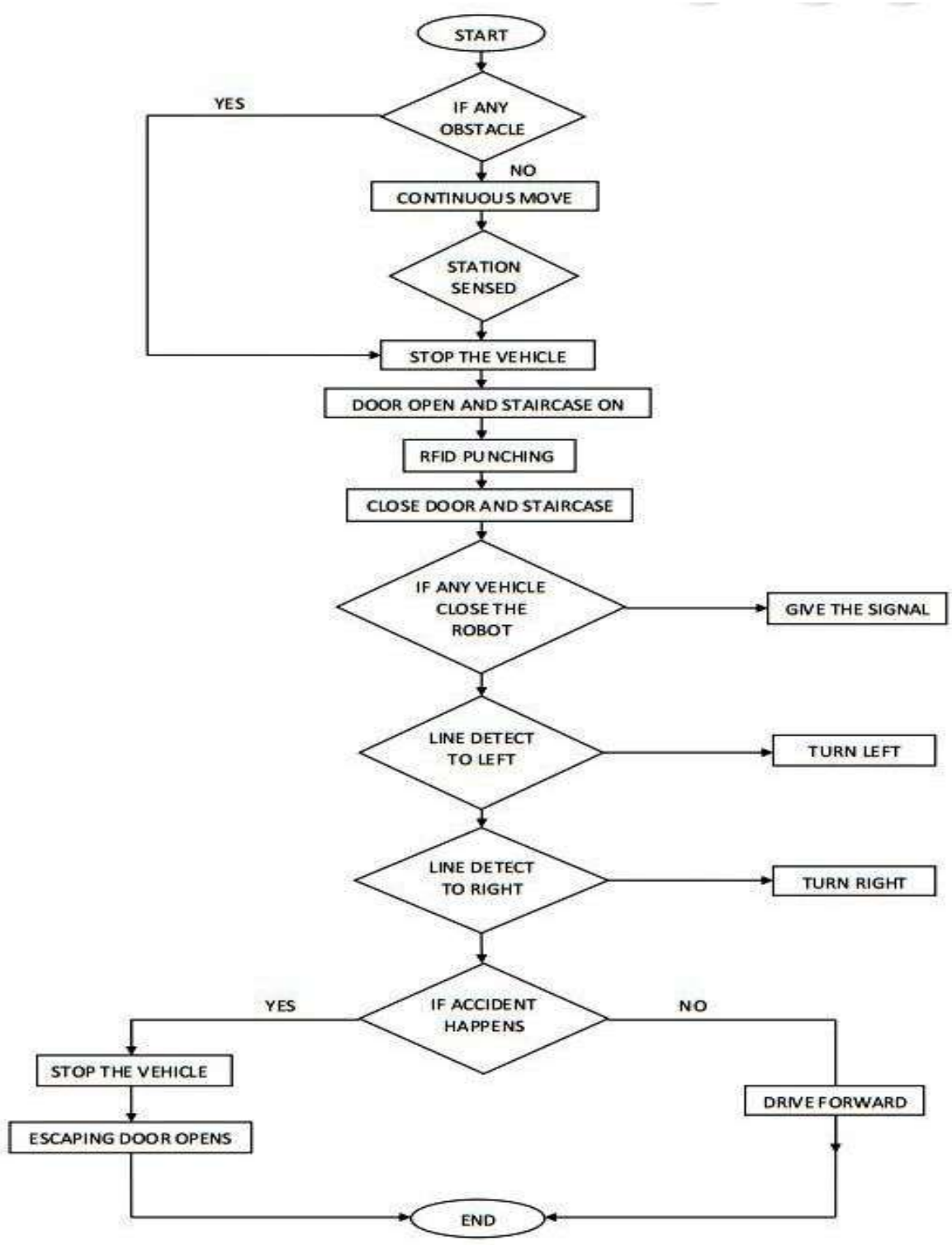

Fig4. Flowchart of Train Bus System (TBS)

Passengers who want to travel in the TBS, the travelling experience for them will be same like normal bus. First they have to go into the bus station by using elevators or lift. The station platform is on same height as the train bus floor. In Train Bus System will run by using "wheel hub motor." The wheel hub motor is also known by wheel motor, wheel hub drive, hub motor or in-wheel motor. An Electric motor is incorporated with the hub of wheel which drives bus directly. The wheel hub motor is mostly used in electric bikes and in electric scooters. In many big cities have remodeled and designed their traffic signaling system, to prioritize public bus. When a bus reaches a crossing, red light on the other side of the signal-fork will turn on automatically and after passing the crossing, the red light will automatically turn off. Immediately after red light, green light will turn on which allow the other vehicles for travel. Indicators are provided in the bus to indicate the turning of the bus on left side or on right side.

Fig4. Train Bus System with Elevated Station

In TBS there are under part indicator system for other vehicles. The function of video monitoring system is continuously monitoring the vehicles which will go to travel underneath the bus. If any vehicles get close to bus side then sensors warns the motorist. Bus has various types of sensors all over the place to ensure that motorist is aware of its height constraint. A hollow out design avoid backward illusion. Power supply equipment is provided in the bus for the passengers to charge their personal electronic gadgets like mobile and laptop. If some emergency condition accidents happens of such a huge bus then how people get out off the bus? Here they provided the most advanced escaping system in the world. In case of some sudden emergency or in fire the escaping door will open automatically. This type of system is used in plane called evacuation system. Emergency braking system is also provided in the bus for emergency situations. Inflated ladders are equipped in planes so people can slide down from it in emergency situation. Blocking Equipment stops upcoming vehicles in emergency condition for passenger's safety. Cameras and sensors are provided in the bus for passenger's safety.

There are some silent features related to the Train Bus System:

- The Train Bus system is optimized solution for traffic congestion and efficient mode of transportation.
- TBS is provided with full sensors that senses if any vehicles get close to bus then sensors warns the motorist.
- Signal controls the traffic and give priority to Train Bus.
- Evacuation system is installed for safety of the passengers. That activated in emergency conditions if accidents happen. Same feature found in Boeing 727 aircraft.
- The bus is fully equipped with various Sensors, Safety instruments, Internet, Wi-Fi, Elevators, Personal facility, Food, Seating arrangement and Power supply equipment.

Fig5. Train Bus System Concept 3D Model (Creo 3.0)

According to Song Youzhou the TBS designer, estimates that the bus can travel up to 60km/h (37 mph). Each carriage can hold 300 passengers and total 1400 passengers. The bus can be save up to 860 ton of fuel/year reducing 2,640 ton of carbon emission.

According to the 2010 report the cost will required about 500 Million Yuan (US $74.5 Million) to construct a bus with 40km (25mi) guide way. TBS not only saves money but also reduced the traffic congestion by 20-30%. He also claimed that each bus cost will be 30 Million Renmini/Yuan (US $4.5 Million).

IV. PROPOSED AND ACTUAL TRAILS

The Cities of Wuhu in Anhui Province and Shijiazhuang in Hebei already applied to get financing. Beijing's Mentougou District of Beijing was carrying out an eco community project; it had already planned out 186 km (115 mi) for out Train Bus in late 2010, but the trial was cancelled because of there were some doubts in the project. The city Manaus from Brazil country signed a contract with the Chinese developers to construct a train bus system in their city.

Later the prototype was presented in Qinhuangdao, a coastal city about 300km (190mi) east of Beijing in mid-2016. In one interview the designers of the bus Song Youzhou said that other four cities of China Zhoukou, Tianjin, Shenyang and Nanyang signed a contract with his company for TBS project of 100 km of tracks beginning 2016.

First test carried out in Qinhuangdao city of 300 m (980 ft) track in August 2016. First Model designed by company named Train Bus System (TBS-1) was 22 m (72 ft) long, 7.8m (25 ft 7 inch) wide and 4.8 m (15 ft in 9 inch) high with capacity of 300 passengers in each carriage. In August 2016, Chinese Media *"People's Daily Online"* said the trail of Train Bus System was complete scam and also claimed that the government of Qinhuangdao was unaware about the trail. After this report of August 2016, investors withdrew themselves from TBS on 9 December 2016. The *Time Magazine* announced a list of "50 Best Inventions of the Year 2010" TBS was one of them.

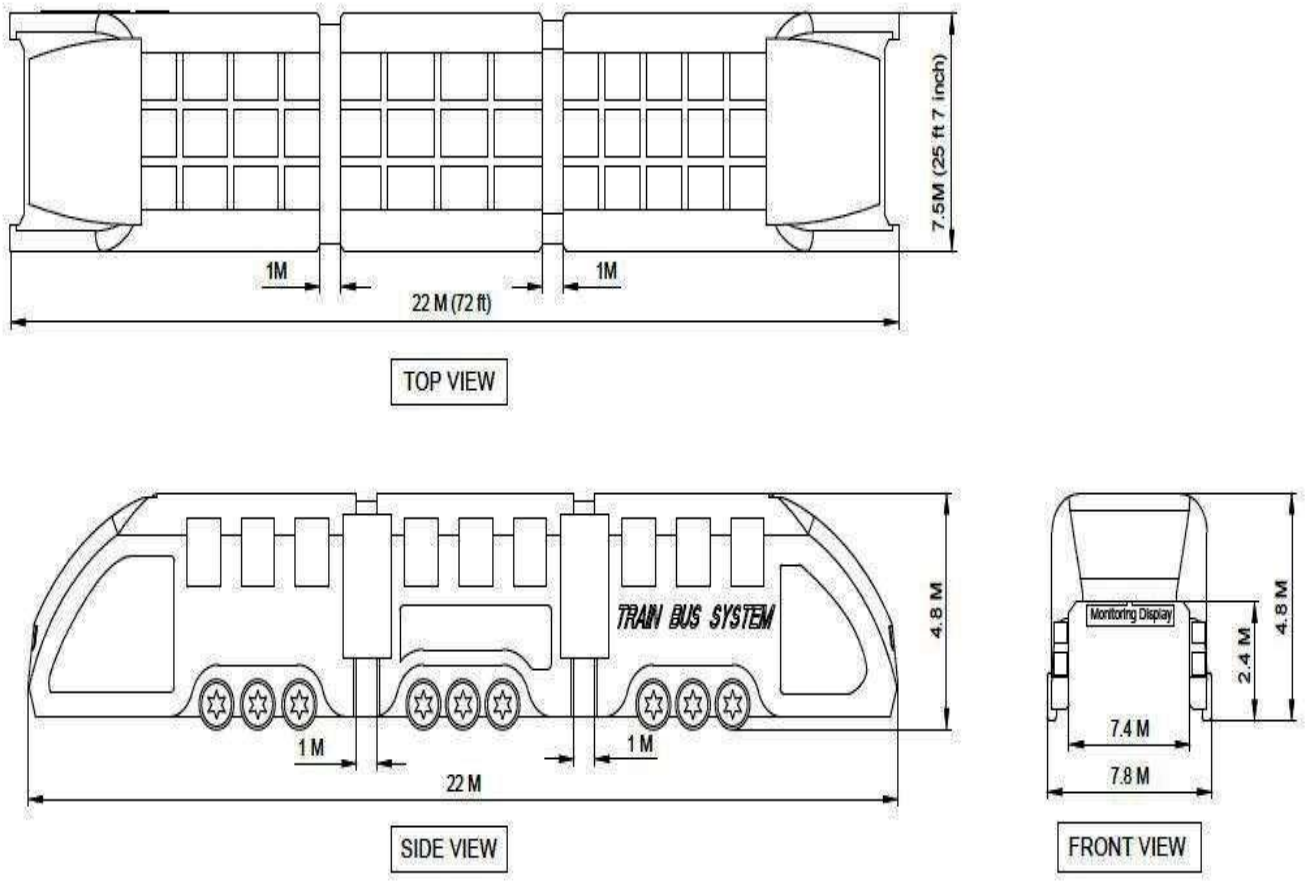

Fig6. Drawing Views of 3D Model TBS

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V. MERITS

- Working and Construction time required very less than BRT and Subway. It can be completed 40km per in one year.
- It completely powered by renewable sources of energy like Electricity and Solar. It can be easily available and pollution free.
- It doesn't occupy extra space on the road and help to decrease the traffic congestion in global countries.
- One Train Bus has capacity to replace about 40 conventional buses in one year.
- The Train Bus System can save up to 860 ton of fuel per year, by reducing 2.640 ton of carbon (Co_2) emission.
- The cost required to manufacture such buses is just 10% of what is used to manufacture the Subways.

VI. DEMERITS

- The construction and mechanism is complex.

CONCLUSION

This concept is very useful to support the mass public transportation system. It provides a solution on traffic congestion that every global country facing today. It can carry large number of passengers which will load on public transport, energy saving and reduce travel time. Train Bus System can be implementing with in very short duration due to its low cost and low settling time. Driverless network or Autopilot technology will help to avoid human error.

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