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Comparison of Perfect/Ideal Urban Transportation System with the Others: Total Travel Times

Ahmet Hakan Selçuk [1,*]
[1]Electrical-Electronics Engineering, Engineering Faculty, Balıkesir Univercity, Balıkesir, Turkey

*Correspondence: aselcuk@balikesir.edu.tr

Özet: Tüm nakliye ve ulaşım sistemleri için en önemli hususlardan bir tanesi de zamandır. İnsan nakil sistemleri için ise zaman daha fazla önem arz eder. O halde, zaman ve maliyeti azaltmak ve emniyeti arttırmak üzerinde çalışmalar yapılmalıdır. Çalışmamızda şehir içi insan aktarımı için tasarlanabilecek bir sistemin özelliklerinin neler olması gerektiği ortaya konularak böyle bir sistemin nasıl olabileceğine dair bir örnek sunulmuştur. Bu özellikleri taşıyan sistemlere de bu çalışmada mükemmel/ideal sistem denilmiştir. Bu çalışma, mevcut/geleneksel sistemlerle, teklif edilen mükemmel/ideal sistemin seyahat zamanları açısından bir mukayesesini ortaya koymaktadır. Şehir içi ulaşımı özellikle büyük şehirlerde zaman, enerji ve kaynak kaybına sebep olmakta, insan vücudu ve ruhu üzerinde olumsuz etkiler yapmaktadır. Mevcut şehir içi insan nakliyatı olması gerekenden çok daha yavaş, tehlikeli ve zordur. Şehir içi insan ulaşımı günümüzde gereklidir çünki şehirler artık eskisi gibi küçük kasabalar halinde değillerdir. İnsanların pek az bir kısmı işlerine yaya olarak gidebilirler. Arkadaş veya akrabalarını ziyaret etmek isteyenler çoğu zaman uzun mesafeler almak zorundadırlar. Mevcut sistemler bu zorluklara çare olamamışlardır. Tavsiye edilen sistemin hemen her meseleyi çözdüğü ve seyahat için harcanan zaman açısından önceki tüm sistemlerden iyi olduğu gösterilmiştir.

Anahtar Kelimeler: Akıllı ulaşım sistemleri, raylı sistem, yolculuk zamanı, hızlı taşımacılık, ulaşım güvenliği, şehir içi ulaşım, akıllı şehirler.

Abstract: For all types of transportations, one of the most important parameters is the total travel time. So, the studies must be focused on reducing the total travel time and cost, while increasing safety. This work is a comparison between total travel times of present/traditional systems and the perfect/ideal system proposed by the author. Urban transportation causes waste of time, energy and resources and has negative effects on the health of human body and soul, especially in big cities. Transportation in cities is much slower, risky and difficult than it should be. Urban transportation is necessary today, because unlike the previous times, the cities are not small towns. Most people cannot go to their works by walking. People have to travel long distances to visit their relatives and friends. Present systems cannot solve these difficulties in anyway. It is proven in this paper that the suggested system solves almost all the problems and calculations show that the travel time becomes much shorter.

Key words: Intelligent transportation systems, railed systems, travel time, rapid transportation, transportation safety, urban transportation, smart cities.

* Corresponding author.
E-mail address: aselcuk@balikesir.edu.tr
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1. Introduction

Systems using the power of animals directly cannot be used in today's transportation systems. Instead, systems consisting of motorized vehicles must be used. Bicycle etc. work with human power. Basically, the thought behind the bicycle is simple and efficient, but it has difficulties because of the limitations of human power. Naturally, in the extension of this thought, electric bicycles and motorcycles are in use. Even though motorcycle transportation is very reasonable, it is not suitable for every person and is affected by atmospheric conditions. To overcome these difficulties, personal automobile may be considered as a suitable vehicle. However, it has some disadvantages like traffic jams, waiting in the junctions and lack of parking locations, so it is not efficient. Furthermore, not every person can have a personal automobile. Another disadvantage of automobile transportation is the truth that if every person has a car, roads and parking areas won't be sufficient. There are minibuses and dolmushs (fill and go taxies or minibuses), midibuses (bus of smaller size), and busses for the people who have no vehicle. This is known as public transportation. Tramway, trolleybus, suburban trains and underground systems are the systems that are supposed logically.

The usage of buses is an important part of the public transportation. They are preferred because of their relative cheapness and capacity. But they have two more disadvantages in addition to moral and safety concerns. At first, it is necessary for them to stop at every bus stop to load and release passengers. Secondly, it has to stop especially at signalized intersections.

None of these systems is the system that brings direct solution which is effective, simple, healthy, safe, fast, quick, low cost and efficient to the urban human transportation problem. Besides the ease and speed that each of them brings, they have serious dangers and disadvantages.

2. Some studies for development of transportation

Many studies have been made to develop present systems for safety and usefulness [1-56]. Many subjects have been concerned to make the traffic flow healthy in or out of the cities. Many detailed studies have been made about the subjects like public transportation vehicle and passenger management [1 - 7], passenger flow control [8, 9], communication between vehicles, automatic passenger and obstacle detection [10 - 15], incident detection and driver warning systems [16, 28], intersection management, traffic lights management and weaving sections design [29 - 39], traffic control [40], road defect recognition systems [42], unmanned vehicles [43 - 44], some new transportation systems [45], train management [46 - 53], artificial transportation systems [54- 56].

The instantaneous position of each bus can be obtained by means of the developed communication technology [1-3]. Almost all of the new approaches depend on the usage of the communication technology and making optimizations by concluding this instantaneous information.

The studies about making bus travel better involve the subjects like bus holding, stop – skipping and priority at the intersections. Bus holding is to make the bus wait at some bus stops. Stop skipping is the action of bus that it does not stop at some bus stops. Both of these methods are suggested and calculated according to the total waiting and travelling times for passengers. Milla et al. [1] optimized the system using fuzzy logic concerning the waiting times for the passengers by organizing with the position information obtained from GPS technology on each bus. Best results are obtained while using both stop skipping and bus holding techniques together. Savings in average passenger waiting times up to 53.04 % as compared to open loop system are reported.

Besides GPS, another technique is to use the busses and stops as communication agents.

Zhao et al. [2] used this information for a distributed control approach using bus-holding strategy.

Hounsell and Shrestha [3] used AVL (automatic vehicle location) system to give priority to the busses at signalized intersections. They offered a differential priority strategy for ITL based intersections considering adjacent buses.

In these type of studies, it is tried to control the distances between the busses to reduce the average passenger waiting times.

[4] uses a multiobjective genetic algorithm for urban bus scheduling problem by creating a pareto solution.

It is obvious that to fill a bus with enough passengers while preserving service quality is another problem. [5] studied on planning night bus routes by means of taxi GPS traces by determining hot areas.

A transit signal priority model is proposed by [6] to minimize time delay at intersections, by taking the bus dwell times and vehicle queue times into account, to predict and optimize.

There are studies like [7] to determine the number of passengers waiting at bus stops in real time. Passenger flow in transportation stations is also a subject for studies [8].

[29] is on a study to view the intersections and determine the situations they may lead to accidents. They used Kalman filter and a multilevel tracking approach for tracking vehicles and pedestrians.

Yang et al. [30] proposed a new signal control for modern roundabouts. There are weaving and merging sections especially for roundabouts having more than two lanes. They tried to eliminate conflicts between approaching and turning vehicles by introducing new stop points. A recording and reporting model for automatic detection of traffic accidents in intersections using cameras is presented by Ki and Lee [32]. They reported a correct detection rate of 50%. Zhao et al. used an algorithm for sensing an intersection using a network of Laser scanners and video cameras [34] and performed an experiment in central Beijing. In [38], an algorithm for optimal single-cycle signal timing for oversaturated intersections is suggested.

The control of 8-phase traffic lights is modelled as Petri net by List and Çetin [39]. They applied petri net to the control of traffic lights and showed that the traffic safety rules are satisfied. They also concluded that signalization of intersections is suitable for hybrid Petri net applications. Febbraro et al. [40] represented the traffic light dynamics by a discrete event model and used this to improve performance of public and emergency vehicles. They validated their proposed model by real traffic data of Toronto.

[41] uses model predictive control (MPC) to reduce emissions and travel delays in urban areas.

Xia et al. [45] suggested a cybernetic transportation system and opened it to public since May 2007 to examine. The system consists of a central control room, cameras and cars.

Chen and Zhou [46] proposed a safety – critical system for china metro. Their system uses some advanced electronic technologies and can be reconfigured to be a triple-modular-redundant system or a dual-modular-duplex-redundant system for different applications. Its reliability, availability, maintainability, and safety (RAMS) are evaluated based on the Markov method.

Sohn [47] claimed that the passengers must be evenly distributed to the metro train cars in order to get the maximum capacity. Passengers prefer nearer cars to them. So, by adjusting the stopping position of the trains, this goal can better be achieved. He proposed a mathematical programming model to determine the best train - stop positions.

Su et al. [48] have studied on optimizing integrated timetable which includes both timetable and speed profiles for energy efficient operation of subway trains. With the operation data from the Beijing Yizhuang subway line they obtained Simulation results of 14.5% energy reduction and a computation time for optimal solution 0.15 s that is fast enough for automatic train operation (ATO).

To ensure reliable, safe, and secure operation of railway systems it may be required to adopt intelligent monitoring systems for railway wagons. Shafiullah et al. [49] developed a forecasting model to investigate the vertical-acceleration behaviour of railway wagons that are attached to a moving locomotive using modern machine-learning techniques.

On non-high-speed lines (standard lines), there exist critical areas like the level or grade crossings where it is necessary to detect the presence of obstacles. García et al. [50] offer to construct a barrier of multiple sensors at both sides of the railway line. The minimum size of an object for which an alarm is required 50×50×50 cm. Their paper proposes the combined use of diverse techniques of data fusion based on fuzzy logic and the Dempster – Shafer theory of evidence, to validate the existence of objects, providing a highly reliable detection system.

Dong et al. [51] introduced a basic framework of parallel control and management (PCM) for emergency response of urban rail transportation and expressed that this proposed framework is able to enhance the reliability, security, robustness, and manoeuvrability of urban rail transport systems in case of an emergency.

Lu et al. [52] tried to obtain energy - efficient train trajectory for a driver guidance system or for an automatic train control system. They used three methods for this: Ant colony optimization (ACO), genetic algorithm (GA) and dynamic programming (DP). They proposed a distance-based train trajectory searching model. It is found that the ant colony optimization, (ACO) algorithm obtains better balance between stability and the quality of the results, in comparison with the genetic algorithm (GA). DP needs additional computation time to increase quality. Wang et al. [53] studied on a topology-based technique for the specification, development and verification of safety critical train control systems.

Artificial transportation system (ATS) concept is very interesting and it helps show the real behaviour of traffic systems. Miao et al. [54] suggested using game engine to simulate real traffic systems. J. Li et al. [55] presented a rule-based iterative ATS design process. L. Li et al. [56] reported on the coordination of the different transportation systems using ATS. They propose an artificial urban transit system (AUTS).

3. Present systems and their disadvantages

The most basic disadvantage of the systems like bicycle, motorcycle, car, minibus, bus, underground etc. is the lack of safety. They are very vulnerable to accidents at any moment. All of the city must be covered with asphalt roads that must be maintained continuously. Underground consists of caves and it is not safe especially at the nights. Public transportation systems especially are in a worse position in this manner. Furthermore, public transportation systems do not work after a certain hour since there will be a very low passenger density. Every vehicle has a driver and a momentary error may cause waste of money and health. These are very expensive systems. Underground/subway is an example of this. It is a very difficult and long-time operation to build these systems. During the construction of a system other systems are affected; buildings, roads, general city profile etc. are damaged permanently or temporarily. Also, digging huge caves under the ground is a very expensive and unnatural operation.

Today underground subway train is presented as the best transportation system. However, even in the best underground, we have to stop and go at every station and there cannot be stations everywhere. To get on an underground train, people should walk a long distance and then go several floors downstairs.

Bus situations are much worse. Passengers standing up in the crowd just like relatives stopping at every bus stop and taking new passengers or leaving, go on their ways. This system is against honour, virtue and innocence. Pollutes air, disturbs psychology. Women, children, old or young, all suffer in the same can of torture.

4. The ideal system

In this section, the principles of ideal/perfect system that can be achieved by using today's technology are discussed.

At first, especially the lack of safety and all other disadvantages must be prevented. It must be safe, fast and quick at the top degree. It must not be dependent on the personal choice. That means it must be same for all people. Working hours must not be limited, it must not wait anywhere. It must be light, low cost and easy to build and remove. It must not need drivers and must be fully automatic. No risk of accident must be present and must be suitable to take measures to avoid accidents. It must always be under supervision and suitable for maintenance, nothing must be interrupted while being repaired or maintained. It must be suitable for young, old, handicapped, all kinds of people. Must allow people carry their personal bags and cases. Waiting time must be at most several minutes, and passengers must reach their destinations in several minutes. It must not pollute the air by burning fuel and its motor systems must be efficient. No waiting or stop must be present during the transportation. Furthermore, it must not wait or interrupt another system and it must not affect on any other installed system or pedestrian traffic.

So,

- The system must use electricity or any other type of clean energy.
- The system must be fully automatic and should be controlled both mechanically and electronically.
- The system must be a railed one.
- The system must be light. That means the mobile carrier parts must not be bigger or heavier than being capable of carrying two adults handling their own baggage with one child.
- The system must contain channels. Each mobile module must choose its way itself automatically. The rails of the channelling points must be fixed.
- The rails must never intersect each other. That means there have to be no junctions. For this reason, it is necessary to use the third dimension, which is the height.
- Each rail must be one-way.
- Rails must be at a certain height from the ground. There is no limit for this, but some stations may be on the ground. Therefore pedestrians and other transportation systems are not affected by the system.
- During the movement, the modules must be covered, otherwise air conditions affect on passengers and safety cannot be provided.
- Modules must be designed such that they do not get out of the rail.
- Service must be payment-free and under the guarantee of the government.
- The module does not stop until it reaches its destination. That's why only a family or friends may get on the same module.
- Person must be able to travel alone.
- Modules follow each other from a safe distance. The speed of the module must be adjusted automatically near channel

separations so that it can provide continuous movement without stopping.

- The system must automatically send the empty modules to the locations those need them.

- Road and module construction and addition must be easy and cheap.

5. Constructability

Various designs may be made. But it can be said that the system will be like roller coasters used in amusement parks. It is not possible to understand why such a light system has not been used in human transportation.

The most important part is the channel choosing system in the design procedure. If it can be done, it will not be difficult to design such a system by using today's mechanical, electrical, electronics, civil and computer engineering and technology.

Several scientific disciplines should work together in the construction and investigation of such a system, so valuable studies, theses, papers will occur during innovations. This will be a valuable field of investigation.

The system has been investigated in the basic manner, the ideas that creates the system has been determined and some models have been designed. The first work on this subject was a homework project given to the students of Firat University Technical Sciences Vocational School, Department of Biomedical Instrumentation Technology in 1998. Then at Balikesir University Faculty of Engineering and Architecture Department of Electrical and Electronics Engineering its model was designed on computer and physically as a graduation project in 2012. This last work was mainly on the rails and channelling system. A brand new channelling system was designed which had no moving part of the rail.

5. A simple explanation of the system

To illustrate performance and to correct and complete possible errors, the simplest road model must be built. The simplest model is the model with two destinations. The destinations are shown in Figure 1. Only two stations are present for simplicity. Some U-turns might be placed along the distance between the destinations. However, to prevent misuse of the system U-turns are not placed. Getting off at the stations and getting on again if necessary will prevent misuse. The system is considered as the travel time is only several minutes in the city.

The mobile parts (may be called capsule, module or car) must be of enough number. In small cities even if the number is low, it will still work properly. Nevertheless, the calculations for the optimum number of cars must be made in crowded and wider cities. By this way, the performance will be perfect and the cost will be at minimum.

It is the best to distribute the cars equally at the stations or in the most adequate manner considering the traffic at that moment. Adequate programs may be used for this. The system should observe everything continuously in local and global manner, as it is directed by logical programs. The system should be supported by emergency routines and mechanical emergency subsystems, because human life should not depend only on electronics. Mechanical measures are essential.

The speed of the modules is limited by the motor systems used and their powers. The main point here is the weight. To supply power, every module may have a motor. However, different designs may be made. Motors on the modules or on the rail or both may supply the thrust for the motion. In the primitive manner, the speeds about 90-100, 50-60, or even 30-40 kph will give very good results as compared to other systems.

The parking areas may be necessary to store or maintain the modules when needed. A representative parking area is illustrated in the Figure 1.

6. Rail network between two points

The simplest rail network structure is the path between only two arrival points. People get on the vehicles only at the stations, except emergency purposes. A parking area is essential to park and maintain the modules. This area can be extended as desired.

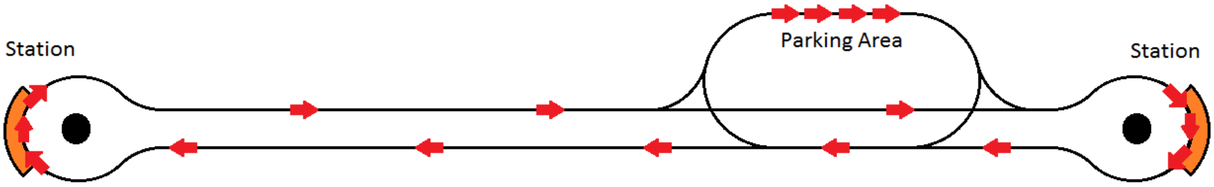

Figure 1. The transportation between two stations.

7. The design made in a graduation project

A design was made in a graduation project in 2012. Some designs were made for the channelling, wheel and rail parts of the system. The basic design for rail and wheel is shown in Figure 2. The rail at the top is completely for safety and it prevents the module getting out of the rail.

Figure 2. *The rail, module and safety line.*

The inner rails are not necessary at the straight sections that are the sections without channels. But they are essential at the channelling sections.

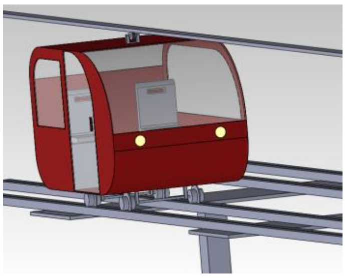

Figure 3. *Safety line (side view).*

For the choice of direction, channelling wheels are designed. These are totally four wheels at both sides. They should be mechanically coupled to prevent accidents. These wheels contact the rail from one side and they pull the module to the desired direction. They become in action at the channelling sections. In Figure 4 the module chooses left rail to go on.

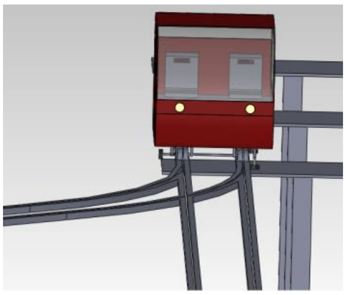

Figure 4. *Channelling part and wheels, channelling left, front view.*

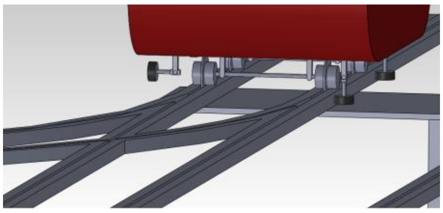

Figure 5. *Channelling part and wheels, channelling left, front bottom view.*

As the module chooses the right channel, the positions of the channelling wheels will be as shown in Figure 6.

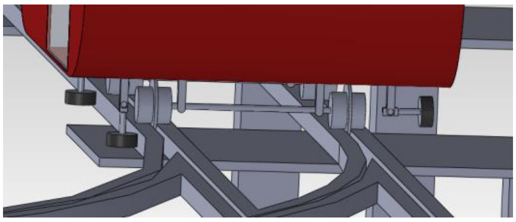

Figure 6. *Channelling part and wheels, channelling right, front bottom view.*

The following Figures 7 and 8 show the details of the slot-like rails at channelling sections. Figure 7 has an angle from top, where Figure 8 is the view exactly from 90°.

Figure 7. *Channelling rails, top view 1.*

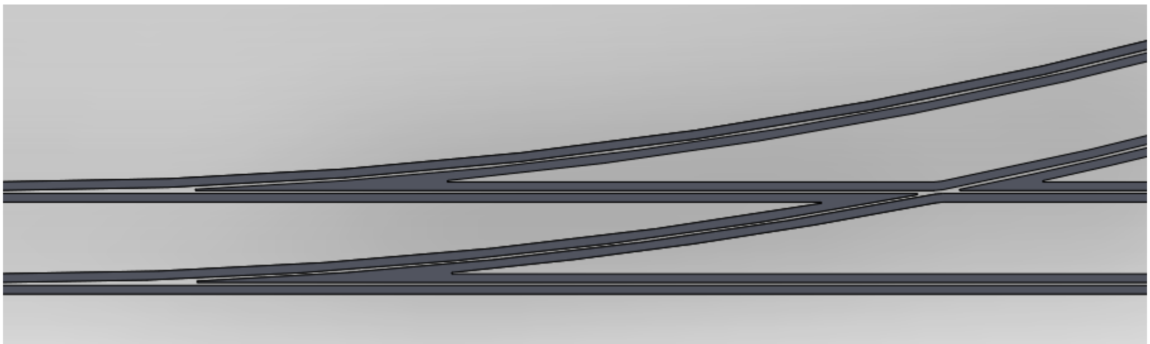

Figure 8. *Channelling rails, top view 2.*

An elevated station design is illustrated in Figure 9. As can easily be understood, modules have to enter the station's way to stop there. This is to prevent stopping all the traffic in the main path. Organization to re-enter the main path is made automatically by control sensors and programs, locally and globally. Acceleration, speed and position must be processed by reliable programs, electronically to produce necessary control signals for the module. Additional mechanical emergency measures are essential to provide safety.

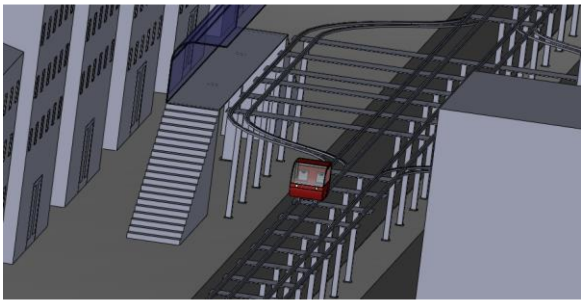

Figure 9. *Station (representative).*

An example of four way junction (note that there are really no junctions) is illustrated as a top view in Figure 10.

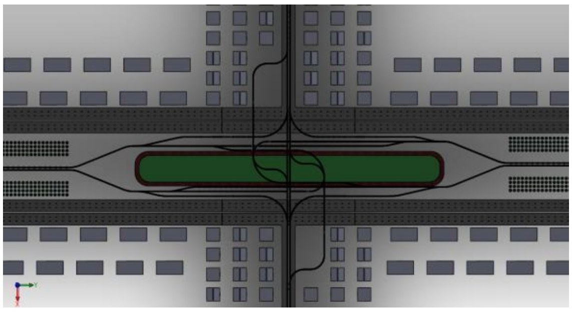

Figure 10. *Representative four way junction.*

A physical model of small size has been constructed to see the details of construction, as can be seen in Figure 11 and 12. The channelling wheels are at a position to select left rail in Figure 11. Left channelling wheels are locked at the left side of the rectangular left rail of the twins-like rail design.

Figure 11. *A practical model of the channelling system, turning left (towards us).*

To select the right path, the right channelling wheels are locked at the position to pull the module to the right in Figure 12. At the same time, the left channelling wheels are pulled up.

Figure 12. *A practical model of the channelling system, turning right (towards us).*

8. Comparisons of travel times of the systems

To compare the travel times of the proposed system and the others, some scenarios are considered.

The simplest route model is the one between only two stations.

8.1. Scenarios between only two stations

Scenario 1: Passengers are on vehicles and ready to go.

As we consider for the first scenario, suppose that the passenger has already got on the vehicle and started moving. It is also assumed that all the vehicles have the same speed.

For the proposed system the travel time to reach the other station will be

$T_{sys} = t_r$.

Since there are no stops, junctions, traffic jams etc. Here, t_r is simply the time that the vehicle reaches from the initial station to the final.

For motorcycle, personal car or bus, the travel time will be

$T_{other} = t_r + t_j + t_{jam}$

where t_j and t_{jam} represent the time spent at the junctions and traffic jams respectively. Since their values are greater than or sometimes nearly equal to zero (in very lucky cases), one can write

$T_{sys} < T_{other}$

When the path becomes more complex, the difference increases since there will be more junctions and traffic jams. In addition, there will be intermediate stations causing the travel time become much longer, especially for bus-like vehicles.

Suppose that between two stations, there are intermediate stops. Then the bus will stop at each bus stop to take and release passengers. So the travel time becomes

$T_b = t_r + t_j + t_{jam} + t_{st}\, n_{st}$

where n_{st} is the number of intermediate stations, t_{st} is average waiting time at each station.

Scenario 2: Passengers are at the station waiting out of the vehicle.

Travel time is a very important measurement for a transportation system, but there are some other stages that must be considered. For instance, the waiting time of the passengers at the stop is an important stage. In a perfect system this time is zero. For the system proposed, this time is considered as not greater than several minutes. The system is considered to be fully automatic and it sends the nearest empty module to the passengers waiting at the stations.

Now we must introduce some more time intervals. First of all the time between the arrival of the passenger at the station and starting the vehicle to move may be defined as the *initialization time* t_i. This time may change from passenger to passenger depending on their arrival times. For instance, the first passenger has to wait until the bus is full and ready to move, whereas the last passenger who arrived at the station does not wait long. This time interval shows differences for each transportation system. As the departure time or the capacity of the vehicle increases, initialization time also increases. Introducing initialization time into the equations gives

$$T_b = t_i + t_r + t_j + t_{jam} + t_{st}\, n_{st}$$

(for bus)

$$T_{c,m} = t_i + t_r + t_j + t_{jam}$$

(for car and motorcycle)

$$T_s = t_i + t_r$$

(For proposed system)

Calculations of t_i's are different for each vehicle or system. In the case of bus, we can talk about different scenarios. For example, if we assume that the bus and the passengers are present at the station and it is to start moving when it gets full, than the initialization time will be

$$t_i = t_g\, n_p$$

(for bus)

Here t_g is the average time for a passenger to get on the bus and n_p is the number of passengers at the bus stop.

Scenario 3: Passengers come to the station one by one.

If the bus is at the station but the passengers are just started to arrive and the bus will start moving when it is full, then

$$t_i = n_p / d_s + t_g \quad ,$$

where d_s represents the *attraction of the station*, which may be defined as the number of passenger arrivals to the station per minute or second. In this case, we should talk about maximum, minimum and average of the initialization time.

If the bus has a departure time and waits until then no matter what happens, then the maximum of the initialization time is the time between two departure times of adjacent buses. The minimum is almost zero if the passenger arrives just at the departure time (ignoring t_g).

In the case of car or motorcycle, if it is assumed that car or motorcycle passengers are present at the station, it will not take long to get on the vehicle. They should wear helmets, get on the vehicle and fasten their seatbelts to start moving. Initialization time will only be that much (t_g).

For the proposed system, the initialization time depends on some parameters. These are waiting time (for an empty module to come) and *safety distance*. It is defined as the time between two adjacent modules needed for the safe operation of the system. Suppose that the station is crowded and there are enough modules at the station. Then

$$t_i = t_g + n_m\, t_{saf} \quad ,$$

n_m is the number of modules to carry n_p passengers. t_{saf} is the safety distance between the modules. It has the dimension of time, although it is called *distance*. n_m changes from $n_p/3$ to n_p, since the passengers may get on a module up to three (one of them being a child).

Scenario 4: Passenger leaves home and arrives at his destination.

In addition to the previous time definitions we should add two walking times, those are t_{w1} (from home to station 1) and t_{w2} (from station 2 to the destination).

For bus-like vehicles, we can assume that the distance for a passenger to walk is equal to the one of the system, since the reasonable stop point distances and concepts are considered to be similar at first.

Considering personal car or motorcycle, the distance to walk may be shorter. On the other hand, the time to get ready on the vehicle and to reach the equivalent station distance may be compared with the walking time. The overall time to reach to the destination will obviously be shorter for the proposed system because of the traffic conditions.

$T_{sys} = t_{w1} + t_i + t_r + t_{w2}$

$T_{c,m} = t_g + t_r + t_j + t_{jam}$

Remark:

If the journey time for the proposed system is less than or equal to the other systems in the case that only two stations are present, then it has a journey time less than or equal to the other systems in the cases that more stations exist.

Proof:

The proposed system has the characteristics that

$t_{jam} = 0$, $t_j = 0$ and $t_{st} = 0$

The other systems have

$t_{jam} \geq 0$, $n_j\ t_j \geq 0$ and $n_{st}\ t_{st} \geq 0$

So, as the number of stations between two points is larger, meaning we have a longer distance, n_{st} will be greater than zero where also n_{jam} and n_j will generally be greater than zero. As the result, the time for a passenger to arrive his destination is less or equal (in very lucky cases) than the other systems.

It is seen that the total time for the proposed system is less than the others.

9. Discussion

The ideal system has a structure that never fails. Even when being repaired or maintained, different line choices may be made automatically. At no point there will be jam or crowd. These can be reached by using appropriate programs.

Our proposed ideal system is much superior to all present systems. That is, even its speed has not been improved yet, its travel time is much better than the present systems. This ideal system must be experienced in smaller towns and then it must be applied to larger cities. These will be very important works.

It is possible to design different rail and wheel types to prevent the modules getting out of the rails. In this work, only one design is given for illustration.

University campuses are very suitable to initiate the experiments. Legality problems can easily be solved by this way at the beginning.

Our ideal urban transportation system will lead to a large working area for civil, electronic, electric, computer engineering and architecture. It will perform a basis in the design of ideal transportation systems between cities also.

The most significant part of this work is the part defining what the features of the ideal system must be. Any system satisfying those conditions can be considered to be an ideal system for urban transportation. An ideal system will contribute to the efficiency, happiness and freedom of human living in the cities.

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