PERSONAL RAPID TRANSIT – POLISH SOLUTION

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Abstract: This article applies to the new transportation system PRT – Personal Rapid Transit. Personal rapid transit (PRT), is a public transportation mode featuring small automated vehicles operating on a network of specially-built guide ways. PRT is a type of automated guideway transit (AGT), a class of system which also includes larger vehicles all the way to small driverless subway systems. In PRT designs, vehicles are sized for individual or small group travel, typically carrying no more than 3 to 4 passengers per vehicle. Guide ways are arranged in a network topology, with all stations located on sidings, and with frequent merge/diverge points. This approach allows for nonstop, point-to-point travel, by passing all intermediate stations. The point-to-point service has been compared to a taxi. This article concerns the methodology of designing such a system. Works on this type of system is carried out, inter alia, at the Warsaw University of Technology under the project “Eco-Mobility”.

Keywords: Personal Rapid Transit – PRT, design principles, computer simulation

1. INTRODUCTION

Selected elements of the PRT system will be presented; among others, the designs of the cabin, the power system and vehicle propulsion system. Particular attention has been paid to customize the system to transit the elderly and disabled, as well as to the principles of passenger interface design. The interface performs a very important role, since the PRT system is a system of APM (Automated People Movers) and there is no driver in the vehicle. There will also be shown some computer simulations relevant to the analysis of traffic and some external influences on the PRT vehicle.
2. THE RESEARCH METHODS

The work used the V-model to design mechatronic systems, and the PRT transportation system is undoubtedly such a system. The aspects presented will be:
   a) the mechanical systems of vehicle and track; b) the propulsion and power supply systems; c) the computer system d) legal and economic aspects. In the design process there has been a strong emphasis on inclusion in the construction of the principles of ergonomics and the needs of disabled and the elderly people. CAx software and simulation techniques have been used as a basic research technique.

2.1. MECHANICAL SYSTEMS OF VEHICLE AND TRACK

Research of the mechanical systems include:
- Passenger cabin – stylish and functional design
- Vehicle guidance system with switchless guideway
- Analysis of motion and external influences on the PRT vehicle

Research on the track system was presented previously at the 13 International Conference of Automated People Movers, 23-26 May 2011 in Paris [CHOROMANSKI].

2.1.1. Passenger cabin design

Research on the passenger cabin system takes into account following aspects:
- Usability
- Safety
- Environment
- Business

According to above aspects the pods should be:
- small (as possible within comfort)
- modularly built
- easing infrastructure flexibility
- equipped with standarized interfaces with infrastructure

Additionally in the cabin system, the subsystems such the following can be identified:
- Chassis frame
- Doors
- Seats and support system for wheelchairs users
- Passenger interface
- Equipment and installations
- Body panels
- The integration of the above mentioned systems
All of the subsystems were built and simulated with the aid of computer models (see Figure 1). Selected results are described and presented in chapter 3.1.

![Figure 1. The computer model of supported PRT vehicle](image)

### 2.1.2. Vehicle guidance system with switchless guideway

Research on the vehicle suspension and guidance system with switchless guideway takes into account laboratory tests on small scaled physical vehicle and computer simulations.

The purpose of the construction of the scale model is a representation of the dynamic effects in vehicle motion on straight and curved track, in the range of acceleration, passing through the junction and deceleration.

In general, the basic equation of motion is expressed as the balance of forces applied to the system, for similarity there is a need to specify the $k_F$ scale factor for all the forces included in the equation (1).

$$m\ddot{x} + c\dot{x} + kx = F$$  \hspace{1cm} (1)

In a polar system we accordingly get the equation (2)

$$I\ddot{\theta} + c_r\dot{\theta} + k_r\theta = T$$  \hspace{1cm} (2)

where: $m$- mass,
I – moment of inertia,
c, cT – damping coefficients,
k, kT - stiffness coefficients,
F – operating forces,
T – applied torque.

For the scale model we accordingly receive.

\[
m \ddot{x} \left( \frac{k_m k_i}{k_t^2} \right) + c \dot{x} \left( \frac{k_c k_i}{k_t} \right) + kx(k_k k_i) = F(k_F) \quad (3)
\]

\[
\left( \frac{k_m k_i}{k_t^2} \right) = \left( \frac{k_c k_i}{k_t} \right) = (k_k k_i) = (k_F) \quad (4)
\]

Using the above specified scale factors we obtain the equation (5) and (6), the fulfilment of those ensures the similarity of scale model.

\[
k_i^4 = k_c k_i = k_k k_i = k_F \quad (5)
\]

\[
k_c = k_i^3, k_k = k_i^3, k_F = k_i^4 \quad (6)
\]

To obtain the full similarity, the scale factors should be specified for the forces acting between the wheels in contact with the track, where describing and defining these forces requires knowledge of the equations that describe the impact of the selected type of contact. For wheels with polyurethane tread application, the work is in progress.

Finally, it has been developed a scaling strategy, indicated with S4, the results of which are shown in Table 1.

### Table 1

<table>
<thead>
<tr>
<th>Sn.</th>
<th>Dimension related:</th>
<th>Values of scale coefficients</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Length</td>
<td>4</td>
<td>(k_i)</td>
</tr>
<tr>
<td>2</td>
<td>Time</td>
<td>2</td>
<td>(k_t)</td>
</tr>
<tr>
<td>3</td>
<td>Density</td>
<td>½</td>
<td>(k_p)</td>
</tr>
<tr>
<td>4</td>
<td>Frequency</td>
<td>½</td>
<td>(k_F)</td>
</tr>
<tr>
<td>5</td>
<td>Surface</td>
<td>16</td>
<td>(k_A)</td>
</tr>
<tr>
<td>6</td>
<td>Capacity</td>
<td>64</td>
<td>(k_V)</td>
</tr>
<tr>
<td>7</td>
<td>Mass</td>
<td>32</td>
<td>(k_m)</td>
</tr>
<tr>
<td>8</td>
<td>Velocity</td>
<td>2</td>
<td>(k_v)</td>
</tr>
<tr>
<td>9</td>
<td>Acceleration</td>
<td>1</td>
<td>(k_a)</td>
</tr>
<tr>
<td>10</td>
<td>Inertia forces</td>
<td>32</td>
<td>(k_F)</td>
</tr>
<tr>
<td>11</td>
<td>Moments of inertia</td>
<td>512</td>
<td>(k_I)</td>
</tr>
</tbody>
</table>
Table 2 shows a set of dimensions for a full scale and for a 1:4 scale model.

### Comparing the selected parameters values for the full scale vehicle and 1:4 scale model

<table>
<thead>
<tr>
<th>Sn.</th>
<th>Parameter</th>
<th>Full scale:</th>
<th>Model 1:4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vehicle mass</td>
<td>1250 kg</td>
<td>~39 kg</td>
</tr>
<tr>
<td>2</td>
<td>LIM mass</td>
<td>300 kg</td>
<td>~9.5 kg</td>
</tr>
<tr>
<td>3</td>
<td>Resistance to motion (without track slope)</td>
<td>2000 – 2750 N</td>
<td>62.5 – 86 N</td>
</tr>
<tr>
<td>4</td>
<td>Maximum velocity</td>
<td>13.5 m/s</td>
<td>6.75 m/s</td>
</tr>
<tr>
<td>5</td>
<td>Operating velocity</td>
<td>2.5 m/s</td>
<td>1.25 m/s</td>
</tr>
<tr>
<td>6</td>
<td>Wheel tread</td>
<td>800 mm</td>
<td>200 mm</td>
</tr>
<tr>
<td>7</td>
<td>Wheel base</td>
<td>1800 mm</td>
<td>450 mm</td>
</tr>
<tr>
<td>8</td>
<td>Support wheels diameter</td>
<td>400 mm</td>
<td>100 mm</td>
</tr>
<tr>
<td>9</td>
<td>Support wheels width</td>
<td>100 mm</td>
<td>25 mm</td>
</tr>
<tr>
<td>10</td>
<td>Minimal guideway radius</td>
<td>5 m</td>
<td>1.25 m</td>
</tr>
</tbody>
</table>

Within the ECO-Mobility project, a unique laboratory test stand for PRT system research has been designed and made.

### 2.1.3. Analysis of motion the PRT vehicle

In order to allow simultaneous activities of team members working on different components of the system, a set of parameters and assumptions was created in relation to vehicle movement profile. Table 3 shows set of parameters (named C1) related to movement resistance of the vehicle. For a defined set of parameters, load profile characteristics were calculated, taking into account typical operation of the vehicle: acceleration to a maximum speed, travel at a maximum speed and deceleration to a full stop (see Figure 2.). Acceleration and deceleration rates were defined according to comfort and safety of the passengers.

The parameters of C1 set are describe in the Table 3 below.

### Parameters set (named C1) used for calculation of resistance to motion of the PRT vehicle

<table>
<thead>
<tr>
<th>Sn.</th>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>m</td>
<td>Overall vehicle mass</td>
<td>1250</td>
<td>kg</td>
</tr>
<tr>
<td>2</td>
<td>V_max</td>
<td>Maximum velocity</td>
<td>13.5 (48.6)</td>
<td>m/s (kph)</td>
</tr>
<tr>
<td>3</td>
<td>w</td>
<td>Limiting guideway gradient</td>
<td>10</td>
<td>%</td>
</tr>
<tr>
<td>4</td>
<td>ρ</td>
<td>Air density (T= 273 °K, p= 0.1Mpa)</td>
<td>1.226</td>
<td>kg/ m2</td>
</tr>
<tr>
<td>5</td>
<td>A</td>
<td>Cabin front surface</td>
<td>2.5</td>
<td>m2</td>
</tr>
<tr>
<td>6</td>
<td>C_x</td>
<td>Cabin shape factor</td>
<td>0.65</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>V_w</td>
<td>Face wind speed</td>
<td>13.5 (48.6)</td>
<td>m/s (kph)</td>
</tr>
<tr>
<td>8</td>
<td>f</td>
<td>Rolling resistance coefficient</td>
<td>0.012</td>
<td>-</td>
</tr>
</tbody>
</table>
Using the above motion conditions, the demand for the driving force and the linear motor power of PRT vehicle has been determined.

### 2.1.4. Analysis of selected external influences on the PRT vehicle

Within the range of calculation of the support frame of PRT vehicle cabin, two types of analysis were conducted – static and dynamical (modal). The static calculations aim was to examine the behavior of the design for several loads variants, including the determination of torsional stiffness. The values of stresses at the critical locations were referred to the basic value defining the material strength.

Modal analysis provided the information on the dynamic characteristics of structural elements at resonances, and thus aids in understanding of the detailed dynamic behaviour of these. The results were compared with the likely types of extortions to indicate a potential resonance in the structure working range.

Within the range of aerodynamic effects on the cabin construction a Computational-fluid-dynamics CFD model of PRT vehicle was built. The calculation conditions were determined for different flow directions and the velocity of the medium (i.e. air), the pressure and velocity distributions, which will become loading (pressure) for the strength calculations supporting the vehicle frame and the door frames. At the same time, the CFD calculations provide the image of pressure distribution on the external surfaces of cab panels, this defines the optimum position of the inlets and outlets of the air conditioning and ventilation.

The basic values of the base wind speed and the wind speed pressure were determined in accordance with the applicable standard. (See Figure 3).
Figure 3. The basic values of the base wind speed and the wind speed pressure in the zones

The selected values of analyses were presented in the paragraph 3.1.

2.2. PROPULSION AND POWER SUPPLY SYSTEM STRUCTURE

Topology of the proposed propulsion power and supply systems directly reflects the agreed concept of the developed PRT system, which assumes use of autonomous vehicles where individual are able to select a route and control their movement. Thus, the guide way contains highly simplified, almost passive components of the power train. Conversely, the vehicle carries sophisticated control and power circuitry. Another feature, which distinguishes the proposed concept is the application of the linear induction motor together with a hybrid power supply of the vehicle. This employs contactless energy transfer together with the supercapacitor energy storage.

Figure 4 shows a block diagram of the proposed power train for developed PRT system. The system is divided into two parts: stationary located on a guide way and the mobile located on a vehicle.

![Block diagram of proposed propulsion and power supply system](image)

Figure 4. Block diagram of proposed propulsion and power supply system

Stationary part contains mainly elements of the power supply system, which are: power
grid connector, matching transformer, diode rectifier and primary side of the contactless energy transfer system. A reaction plate of the linear induction motor, used for vehicle propulsion is placed on a guide way, additionally.

The vehicle carries the secondary side of the contactless energy transfer system, vehicle energy management system and primary winding of the linear induction motor, together with motor inverter.

### 2.2.1. Contactless energy transfer (CET) system

Figure 5 shows the concept of a transformer [PEDDER], where primary winding, in the form of a loop, is distributed along PRT guide way. The E shaped core, with secondary winding, mounted on the center column creates energy pickup and it is placed on the vehicle.

Primary winding is supplied with sinusoidal current. In order to provide the required magnetic coupling, the frequency of the current should be in the range of tens of kilohertz. Respectively, due to primary winding distribution, the current amplitude should range hundreds of amperes. Since the vehicle must cover guide way junctions or following sections of the primary winding, the core of the pickup must be open, to enable safe operation in that areas. As a result, the magnetic circuit of the transformer is characterized by significant amount of leakage inductance. Therefore, in order to transfer the required amount of active power to the vehicle, significant reactive power must be delivered to the magnetic circuit, at the same time. This problem was solved by putting a compensation network made of capacitors, in series with the primary loop. The capacity of the network is selected to meet the resonance criteria for supplying current frequency. As a result, reactive power is exchanged between the capacitors and the leakage inductance of the transformer and does not need to be delivered by the converter. Such an arrangement improves operational conditions of the supplying inverter, because it can operate in soft switching mode, which substantially reduces heat losses generated in power electronics switches.

![Front view](image1)
![Side view](image2)

**Figure 5.** Concept of contactless energy transfer system for PRT

During travel, the vehicle can slightly change its position relative to the transformer primary winding, due to not perfect surface of the track or especially when covering difficult sections of the track, like junctions or turns. Thus, the magnetic circuit of the
transformer will change, loosing its resonance condition. As a result power transfer will be impeded. Such changes can be detected by the control circuit and loop current frequency can be adjusted to avoid this situation.

Application of contactless energy transfer introduces significant advantages to conventional vehicle supply system based on pantographs, such as

- Increased immunity to weather conditions
- No electric arc
- Practically maintenance free system
- Reduced risk of electric shock to the users

In order to reduce the power rating of the Contactless Energy Transfer System a hybrid solution was proposed, which utilizes a supercapacitor as an energy storage located on the vehicle. The storage delivers peak power to the propulsion during acceleration and takes back the energy recovered during regenerative breaking. In addition, it allows travel of the vehicle through track sections, where usage of contact less energy transfer is difficult or impossible like track junctions or hard turns.

### 2.2.2. Linear Induction Motor drive for PRT vehicle propulsion

It was decided to use a Linear Induction Motor (LIM) for vehicle propulsion. Figure 6 shows a cross section of flat type linear induction motor used in proposed PRT system concept.

![Cross section of a Linear induction motor](image)

Figure 6. Cross section of a Linear induction motor

The motor forcer is located on the bottom of the vehicle and contains copper windings wound on a magnetic iron core. The winding is supplied from the microprocessor controlled power electronics inverter, which allows smooth control of a thrust force during acceleration, steady state and deceleration. Energy recovery can be controlled, additionally. An aluminum reaction plate, together with the stator core are located on the vehicle track.

Application of this type of the propulsion provides the following benefits related to use of conventional rotary motors to the PRT system:

- Direct source of thrust/breaking force
- Low sensitivity to the environmental conditions like icing/snow or rain
• Low maintenance cost
• Low noise
• Increased reliability

Some difficulties are associated with linear motor application, which are: reduced efficiency, high attraction force between the forcer and the stator core, motor magnetic circuit end effect and variable airgap. High attraction force require higher strength of vehicle suspension, but can stabilize the vehicle during turns. Motor magnetic circuit end effect and variable airgap lead to performance deterioration of the thrust force production, but can be compensated by the control scheme. Finally, increased energy cost maybe compensated by reduced maintenance effort.

2.3. ERGONOMIC DESIGNING OF VEHICLE PRT PASSENGER SPACE

The research presented in this paper refers to designing of vehicle PRT cabin, fitted to the needs of the potential users. This group is varied from the point of view of dimensions, ages and abilities. Knowing the differences and needs meant they could be taken into account in the cabin design. The PRT vehicle is remote control, that is why the passengers should only make some manual steering actions during the trip. The projecting process of the functional and ergonomic vehicle required a considerable amount of research and analysis, inter alia:

• Questionnaire/expert-based surveys (the disabled people were the group of experts),
• Anthropometric verification of vehicle passenger space, from the point of view users dimensions,
• Analysis of manual handling possibilities of touch screen interface (simplicity and intuitiveness of interface handling will vivificate with ready-made interface with the participation of different groups of users).

A questionnaire-based survey included two groups of people who are moving on the active wheelchairs. The first group size was 12 people, the second – 15 people. The analysis of the level of efficiency of the manual handling among the disabled respondents revealed some small difficulties, but generally there was no problem with manual operations by the upper limbs. The computer dummy man, based on Catia software and direct methods were used in the anthropometric verification. Both, the dimensions of the smallest individuals (C5 ♂) and the largest ones (C95 ♂) taken into account. In this case the largest analyzed person was C95 man, sitting in the wheelchair, the height of which was 52 cm (according to the standards). The interface design demanded the initial dimensional and availability areas on the touch screen analysis in order to allow people with lower efficiency of the upper limbs correct handling.
3. THE ANALYSIS OF RESEARCH RESULTS

3.1. SELECTED RESULTS OF THE MECHANICAL SYSTEMS

In order to verify the proposed PRT mechanical concept a series of simulation tests were performed.

3.1.1. Strength analysis of PRT vehicle cabin frame

The worst case for the important frame elements occurs when the frame is twisted, subjected to the wind force (pressure), during braking or driving around the curve. The selected results presents Figure 7.

Figure 7. Mean stress distribution- (torsion case)
3.1.2. Analysis of Computational-fluid-dynamics

The maximum value of the gust is 26 m/s (93.6 kph). It has been assumed that the top speed of blow is 100 km/hr. At the same time, it has been assumed a maximum speed of vehicle is 50 km/hr. The following are some cases that correspond to the states of motion (see Figure 9 and Figure 10)

Figure 9. Case A – speed of 25 kph, steady state, no gust, a case verifying a pressure distribution at lower speeds

The case E (see Figure 10) corresponds to the situation when the vehicle is stationary and it is a subject to the side gust of the maximum speed.
Figure 10. Case E – vehicle speed of 0 kph, the side gust value of 100 km/hr.

The selected results as below (see Figure 11 and Figure 12).

Figure 11. Case A – Contours of static Pressure (Pascal)
3.2. PROPULSION AND POWER SUPPLY SYSTEM STRUCTURE - SIMULATION AND EXPERIMENTAL TESTS

In order to verify the proposed PRT power train concept a series of simulation and experimental tests were performed.

3.2.1. Contactless energy transfer

Figure 13 shows the schematic of the scaled laboratory model of CET. It should be noticed, that figure 13, shows a variant of the CET, where the matching transformer is located at the high frequency side. As a result, the size and a cost of this element can be significantly reduced.

The setup is supplied from a variac through a simple diode rectifier. Thus, smooth input voltage regulation for the resonant converter is possible, for experimental purpose. The capacitor network was located on the input of the matching transformer. Thus, leakage inductance of both transformer and the loop are compensated. A single 3.5 m loop was interchangeable and was constructed using different types of copper conductors like litz wire or copper pipes.
An E shaped pickup was able to be moved along and in the direction perpendicular to the axis of the loop. The output section of the system contain secondary side compensation capacitors together with diode rectifier and variable resistor load. The output circuit models drive inverter. The setup allows the measurement of the power flow at different points of the system, which in turn allows verification of energy transfer efficiency. Moveable E-Shaped energy pickup simulates movement of the vehicle, which causes the loop to move inside the pickup. Finally, the system is controlled by a real-time control scheme, implemented on an ARM type microprocessor. The main objective of the controller is to measure state of the circuit and adjust loop current frequency, so the resonance is always maintained.

Figure 14 presents selected results taken from measurements of the laboratory setup. Correct operation of the CET system is shown on figure 14a. The resonant converter operates at 30.4kHz, loop current amplitude is 186 A rms. The output voltage is 185 V rms and the transferred power is 1.2 kW.
Figure 14. Selected waveforms and characteristics taken from experiments on a scaled laboratory model of Contactless Energy Transfer system.

Figure 14b shows set of CET transformer efficiency characteristics measured for different supplying voltage amplitudes. Finally, the last figure presents set of CET system output characteristics.

It can be seen from the results presented that the CET is able to provide efficient power supply for the PRT vehicle.

3.2.2. Simulation of the Linear Induction Motor drive

Selected control method (FOC) for linear induction motor drive uses dynamic state estimator based on machine equivalent circuit. Thus one of the simulation tests objective was to evaluate the linear induction motor equivalent circuit, which takes into account end effects. The model was proposed by [DUNCAN]. Additionally, performance of the Field Oriented Control Method (FOC), with the modified machine state observer [LIU], was evaluated. For this case, a simulation model in MATLAB/SIMULINK was created as shown in Figure 15. Linear motor equivalent circuit model parameters were obtained from motor laboratory tests.
Figure 15. Simulation model of Linear Induction Motor drive taking into account end effects

The circuit on the upper part of the figure (light color filled blocks), contains the equivalent circuit without modeled end effect. The equations of the model are identical to the classic rotary motors. The block on the lower part of the figure, represents the extended model, which considers end effects phenomena.

Figure 16 shows an example of simulated performance of the control method, as well as state estimator for both linear motor models.
It can be shown from simulation experiments results, that extending linear machine model by equations describing end effect phenomena, may lead to drive performance deterioration in a form of thrust force oscillations.

3.3. ERGONOMIC DESIGNING - THE ANALYSIS OF RESEARCH RESULTS

As a result of both research and analysis, the design procedure of the ergonomic vehicle design was defined and the initial assumptions were made regarding construction and ergonomics. The assumptions, aimed at adapting the vehicle to people with different levels of physical ability, were created on the basis of opinions of experts recruited from the group of disabled people. When designing the interior and the equipment of the PRT vehicle’s cabin, the following anthropometric parameters should be considered:

- The user’s position/preferred wheelchair’s position – forward-facing
- The forward grip reach
- Securing comfortable drive
- Measures of potential users, both with high level of physical ability and the ones on wheelchairs.

Assuming that passengers’ seats can face each other and can be folded down only in case they are backward-facing, the wheelchair can be put in two positions after it is fixed inside the cabin. In both cases the wheelchair is fastened to seats’ backrests and in each of them it is being situated slightly differently in relation to the cabin’s equipment, especially the screen, that is, passenger’s interface. This situation has a considerable influence on determination of cabin dimensions, securing the access to key elements of its equipment. The Figure 17 presents the project of seats’ configuration inside the cabin and the wheelchair position, elaborated with the help of CATIA software.
With the use of computer dummy man, the cabin space available for all PRT passengers has been marked. Securing the screen accessibility to the smallest person on the wheelchair, that is $C_5 \, \mathcal{F}$, is in this case a sufficient condition. Installation of two screens, situated on opposite walls, will enable their handling with the use of the right hand, depending on the wheelchair position in relation to driving direction. The Figure 18 presents the reach area for the smallest person on the wheelchair.

Figure 17. Location of the wheelchair inside the cabin of PRT vehicle: a) forward-facing, b) backward-facing

Figure 18. The position of two passenger’s interface screens
The key functionality of the touchscreen (steering device) is to allow as many people as possible to select their destinations. The interface is located inside the cabin so that the passengers are able to change their destinations at any time. The key assumptions behind the service methodology and graphical layout are as follows:

- Finding source of information
- Discerning information
- Understanding information or a signal.

In order to enable finding and understanding the information, its screening has to be legible. Securing the detection of the information will result in high level of understanding and intuitive use of graphic interface. The graphic elements of the screen (icons, symbols) has been accompanied by adequate comments, so that a wide group of users, including elderly, could use it in an easy and comfortable way. The fact that the user can predict the reaction of the graphic interface to his previous actions proves its intuitive use. It results in efficient and comfortable use of the programme and the lack of additional user’s manual and, consequently, the need for teaching the user. The interface consists of a number of screens: welcome screen, screens for selecting destination, screen confirming the choice of final destination and screen active between the stops. The Figure 2.2 presents function buttons of the touchscreen as well as sample of screens appearing while choosing the final destination of the journey.

![Figure 19. Function scheme of the screen and examples of interface screen](image)

### 4. CONCLUSIONS

The PRT network could be considered as an alternative transportation system, particularly in the urban areas or where the transportation infrastructure (roads, railways, etc.) is poorly developed. The work has demonstrated that the PRT network can effectively replace the current operating transportation systems. In Poland, local installations of PRT networks are planned in several urban conurbation and in selected areas of special character (i.e. in national parks).
ACKNOWLEDGEMENTS

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REFERENCES


PERSONAL RAPID TRANSIT – POLSKIE ROZWIĄZANIE

Streszczenie: Artykuł dotyczy nowego system transportowego określonego w literaturze anglosaskiej terminem PRT (Personal Rapid Transit). Transport ten należy do tzw systemów ATS (Automated Transit System) i składa się z małych pojazdów poruszających się po lekkiej infrastrukturze nadziemnej. Pojazdy sterowane są automatycznie i realizują tzw transport „door to door” tzn poruszają się od przystanku początkowego do końcowego bez przystanków pośrednich. W pracy przedstawiono wyniki prac nad tego typu transportem zrealizowanym w ramach projektu ECO-Mobilność.

Słowa kluczowe: Personal Rapid Transit - PRT, zasady projektowania, symulacja komputerowa