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Two Scenarios for Ultra-Light Overhead Conveyor System in Logistics Applications

Batin Latif Aylak and Bernd Noche

***Abstract*—**Overhead conveyor systems are in use in many installations around the world, meeting the widest range of applications possible. Overhead conveyor systems are particularly preferred in automotive industry but also at post offices. Overhead conveyor systems must always be integrated with a logistical process by finding the best way for a cheaper material flow in order to guarantee precise and fast workflows. With their help, any transport can take place without wasting ground and space, without excessive company capacity, lost or damaged products, erroneous delivery, endless travels and without wasting time. Ultra-light overhead conveyor systems are rope-based conveying systems with individually driven vehicles. The vehicles can move automatically on the rope and this can be realized by energy and signals. Crossings are realized by switches. Ultra-light overhead conveyor systems provide optimal material flow, which produces profit and saves time. This article introduces two new ultra-light overhead conveyor designs in logistics and explains their components. According to the explanation of the components, scenarios are created by means of their technical characteristics. The scenarios are visualized with the help of CAD software. After that, assumptions are made for application area. According to these assumptions scenarios are visualized. These scenarios help logistics companies achieve lower development costs as well as quicker market maturity.

***Keywords*—**Logistics, material flow, overhead conveyor.

I. Introduction

THE manual overhead truck is the simplest and oldest conveyor technology. Trolleys are running in a wood rail profile, which are manually displaceable and able to carry loads with different geometries and weights. Main area of use is the flexible connections of individual processing areas, which are not chained automatically as a rule. The process happens manually. The transport way is usually horizontal, larger increases and slopes can only be managed by driven means.

Overhead conveyor systems become particularly suitable as demands to the conveyor systems rise. This way, speed, high availability, high loading capacities and high position accuracy can be achieved [1]. Due to its control system travelling with it, the system offers an optimal material flow and a highest degree of flexibility for a great variety of applications. Each vehicle of overhead conveyor is equipped with a control system travelling with it, which conveys in a suitable way with the central control system. The control commands are relocated and controlled on board in chassis functions, such as driving, stopping, speed regulation, lifting or commissioning and discharge of transport goods respectively [2]. A permanent or variable coding of drives allows the alignment and administration of driving orders as well as carrying along of process data for the purpose of material flow control.

Ultra-light overhead conveyor systems are much more flexible than ordinary monorail conveyors and can practically follow any path to adapt to any transport plan. Its bolt construction enables a lot of configuration possibilities.

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II. Components of the First Scenario

Main components of the first scenario are shown and explained here:

- **Rope**

Ropes are important part of ultra-light overhead conveyor systems for the transportation.

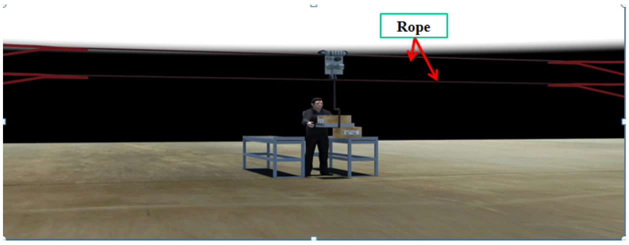

Fig. 1 Rope of the first scenario

Fig. 1 represents rope of the system for the first scenario. The vehicles can move automatically on the rope. An appropriate rope must be selected for the system. According to static analysis the rope should be chosen. Here it is important, that breakpoint of the rope must be taken into consideration, otherwise a healthy transportation procedure could be compromised. Thus, selection of the appropriate rope is very important in order to design a new ultra-light overhead conveyor system.

- **Vehicle**

Ultra-light overhead conveyor vehicles consist of a friction wheel drive and an attached support part correspondent to the load-handling device.

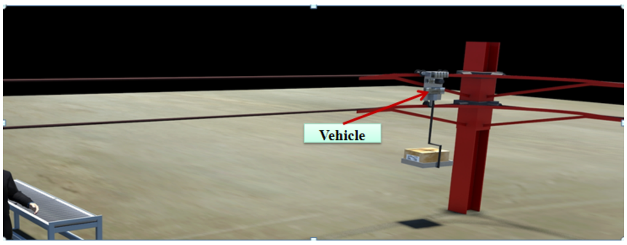

Fig. 2 Vehicle

Fig. 2 represents vehicle of the system for the first scenario. The vehicles are mostly equipped with non-contact collision protections (initiators, light sensors, ultrasound sensors) and have a control system of their own. For the most part, the vehicle control system is comprised of the selection of the drive unit, surveillance of the engine, surveillance of additional electrical components and the collision protection [6]. Normally, ultra-light overhead conveyor vehicles do not have any lifting device, since the number of transfer points is low with respect to the number of vehicle and thus the load transfer process is managed with vertical-transcribers or hub stations.

- **Columns**

These columns are consisted of either steel or wood. They help to fix ropes on the points.

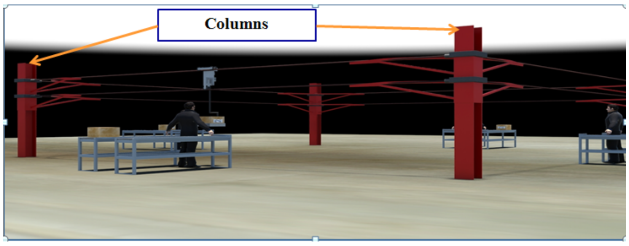

Fig. 3 Columns

Fig. 3 represents the columns of system. Moreover, clamping device will be used in the system in order to tense ropes between the columns. The specifications of columns should be also determined.

- **C Rails**

C Rails are made of steel. They provide the steering on the corner points of the system.

Fig. 4 C Rails

Fig. 4 represents C Rails of the system. They have also holders in order to strengthen toughness of the columns.

- **Stepper Motor**

A stepper motor is a special type of electric motor that moves in increments, or steps, rather than turning smoothly as a conventional motor does.

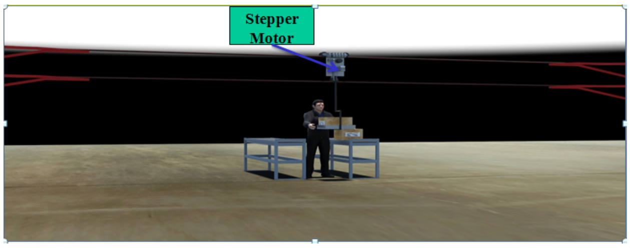

Fig. 5 C Stepper Motor

Fig. 6 represents stepper motors of the system. The motor divides a full rotation into a number of equal steps. The position of motor can be commanded to move and hold at one of these steps without any feedback sensor.

III. Components of the Second Scenario

Main components of the second scenario are shown and explained here:

- **Rope**

Ropes are important part of ultra-light overhead conveyor systems for the transportation.

Fig. 6 Rope of the second scenario

Fig. 6 represents rope of the system for the second scenario. The vehicles can move automatically on the rope. An appropriate rope must be selected for the system. According to static analysis the rope should be selected. Here it is important, that breakpoint of the rope must be taken into consideration, otherwise an healthy transportation procedure would be compromised [9]. Thus, selection of the appropriate rope is very important in order to design a new ultra-light overhead conveyor system.

- **Vehicle**

Ultra-light overhead conveyor vehicles consist of a friction wheel drive and an attached support part correspondent to the load-handling device.

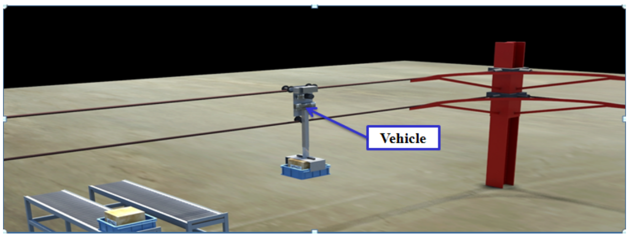

Fig. 7 Vehicle

Fig. 7 represents vehicle of the system for the second scenario. The vehicles are mostly equipped with non-contact collision protections (initiators, light sensors, ultrasound sensors) and have a control system of their own [7]. For the most part, the vehicle control system is comprised of the selection of the drive unit, surveillance of the engine, surveillance of additional electrical components and the collision protection. Normally, ultra-light overhead conveyor vehicles do not have any lifting device, since the number of transfer points is low with respect to the number of vehicle and thus the load transfer process is managed with vertical-transcribers or hub stations.

• **C Rails**

C Rails are made of steel. They provide the steering on the corner points of the system.

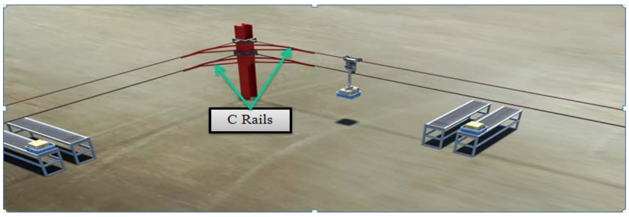

Fig. 8 C Rails

Fig. 8 represents C Rails for the second scenario. They have also holders in order to strengthen toughness of the columns.

• **Columns**

These columns are consisted of either steel or wood. They help to fix ropes on the points.

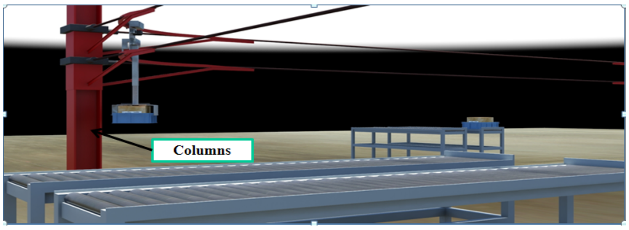

Fig. 9 Columns

Fig. 9 represents the columns of system. They are same as like in the first scenario. Moreover, clamping device will be used in the system in order to tense ropes between the columns [4]. The specifications of columns should be also determined.

• **Stepper Motor**

A stepper motor is a special type of electric motor that moves in increments, or steps, rather than turning smoothly as a conventional motor does.

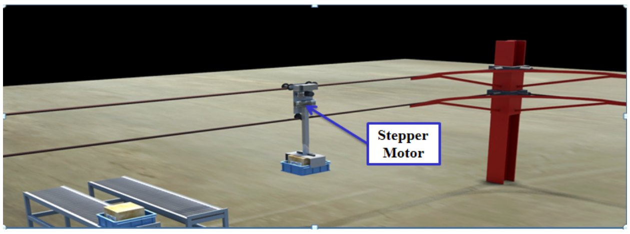

Fig. 10 Stepper Motor

Fig. 10 represents stepper motors of the system. The motor divides a full rotation into a number of equal steps [5].The position of motor can be commanded to move and hold at one of these steps without any feedback sensor.

• **Robotic Gripper**

Gripping and holding of objects are key tasks of the robotic grippers. The robotic grippers are able to pick up objects of widely varying shape [3]. The robotic gripper can be of two fingers, three fingers or even up to five fingers.

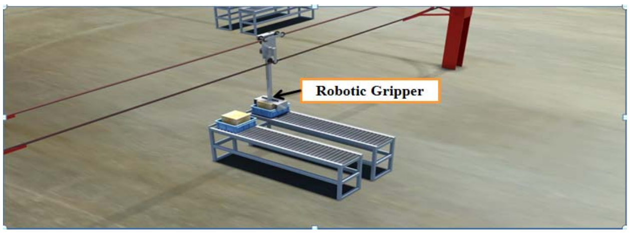

Fig. 11 Robotic Gripper

Fig. 11 represents the robotic gripper of the system. The gripping mechanism operates by the grippers or mechanical fingers. Two finger grippers are widely used in industry. In this case, two finger grippers are used. The robotic grippers have simple mechanisms.

IV. Processes of the Scenarios

Here the processes of the scenarios will be explained:

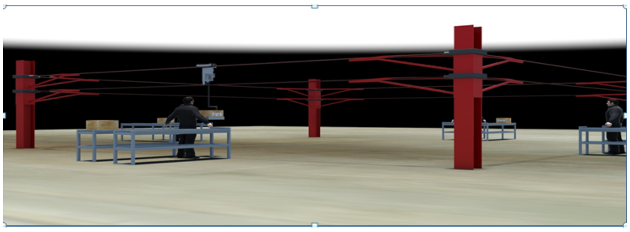

Fig. 12 Entire System for the First Scenario

Fig. 12 represents entire system for the first scenario. The first scenario consists of 4 columns, 2 circumferential ropes, 4 deflection pulleys, 1 vehicle with linkage, 1 bin and 1 box per vehicle for the energy supply, stepper motors and control units. The vehicle pends on two vertically parallel ropes and it moves on the ropes with its own energy supply. Payload is transported in the bin. The bin and vehicle are connected with linkage. Size of application area is $10m^2$ assumed. Moreover, the vehicle supplies 4 loading and unloading stations. The stations are supplied manually. The vehicle moves from one station to another station. Material flow is only in one direction. Loading and unloading of the payload in and off the bin are realized manually at respective stations. This scenario is about human procedure.

The second scenario consists of 4 columns, 2 circumferential ropes, 4 deflection pulleys, 1 vehicle with linkage, 1 robotic gripper and 1 box per vehicle for the energy supply, stepper motors and control units. The vehicle pends on two vertically parallel ropes and it moves with its own energy supply on the ropes. Payload is transported by the robotic gripper. The robotic gripper and vehicle are connected with linkage.

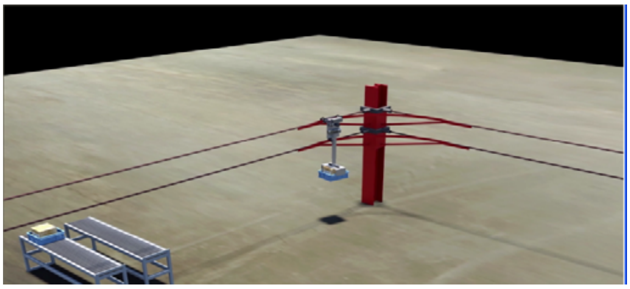

Fig. 13 Entire System for the Second Scenario

Fig. 13 represents entire system for the second scenario. Size of application area is $10m^2$ assumed like in the first scenario. Moreover, the vehicle supplies 4 loading and unloading stations. The stations are operated by robotic gripper. The vehicle moves from one station to another station. Material flow is only in one direction. The robotic gripper takes payload at the loading station and then payload is unloaded by the robotic gripper at the unloading station. This scenario is about automated procedure.

V. Conclusion

The robust technology and the high degree of flexibility secures an optimal procedure and guarantees the article and target oriented material flow in any company. Ultra-light overhead conveyors can be adjusted to any individual need of carrier ability and conveyor speed and can be combined with other systems. These inexpensive scenarios are used with facilities with low piece goods or with lighter loads. The conveyor technology considerably influences the effectiveness of the entire system [8]. The majority of researches and applications deal with overhead conveyor as partial feed system for production systems, particularly for the automotive industry. There is not only one crab on the ropes, but lots of vehicles along one or several given routes. Furthermore, their automation is possible in a simpler, more economical and more effective way.

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