

## POSSIBILITIES OF USING DRIVERLESS HANDLING ROBOTS IN INTRALOGISTICS

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**Abstract** *In this article, we address production logistics within internal logistics, along with production material supply, related material handling, and the utilization of material handling robots to support processes. Robot navigation is a multi-approach discipline that poses a major challenge in intralogistics. In general, the navigation principle, software and hardware requirements of mobile robots must be prepared on the basis of logistics processes in such a way as to satisfy production with sufficient accuracy and safety. In the article, we present the types of robots and give insight about autonomous mobile robots. Additionally, we examine the importance of real-time data exchange and communication systems in optimizing the performance of material handling robots within the production environment. Furthermore, we explore the potential benefits of incorporating machine learning and artificial intelligence algorithms to enhance the autonomy and decision-making capabilities of these robots. Through a comprehensive analysis, we aim to provide a holistic understanding of the role of material handling robots in modern production logistics and their potential impact on efficiency and productivity.*

**Keywords:** *intralogistics, driverless forklift, logistics, material handling*

### 1. INTRODUCTION

In this article, we examine the possibilities of using driverless material handling robots. In our view, self-propelled robots can be used in many areas. Based on our experience, self-propelled robots are used for material transport in many areas of industry. In general, manufacturing plants employ a lot of people to transport products, raw materials and components within the production facility, which is a low-skilled task and due to today's labor situation, it is difficult to find employees. In many production plants around the world, many people are engaged in simple material handling, such as pushing trolleys. This often physically demanding work does not contribute to an increase in the value of the finished product. For these reasons, we feel desirable to automate material handling. In our article, we present the possibilities of automating material handling. In the logistics of smart factories, my car material handling machines play an important role. Due to the spread of smart factories and in the light of rapidly developing technologies, the issue of automation is gaining more and more importance in various fields.

During the research, we focus on their use in intralogistics, i.e. their application in internal logistics. Another goal of our research is to find, examine and analyze existing mobile robots. Based on these, we try to establish recommendations that can serve as a starting point for the deployment of autonomous mobile robots. In the course of the research, we will also present the operation of autonomous mobile robots, and we will also discuss the errors and shortcomings of the devices, for which we will propose improvements.

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## 2. THE INTRALOGISTICS

Based on domestic and foreign sources, the term intralogistics means internal logistics. In my article we would like to deal mainly with production logistics and the supply of production materials within internal logistics. Material handling is a multifaceted activity that is organically integrated into all sectors of the economy. The mechanization of material handling is an important tool for increasing productivity as it relieves people from demanding physical work. The mechanisation of material handling is therefore also of great social importance. The worker engaged in lifting, transporting and loading is not only spared strenuous work, but at the same time freed up to perform higher work [1].

According to the "Hungarian Interpretative Manual Dictionary", the meaning of the word material handling is: "The (in-plant) transport of necessary (raw) materials, workpieces, etc. to the appropriate workplace." [2].

In general, the concept of material handling means that raw materials are semi-finished and finished products or goods are not deformed in order to change location. Its task is to serve the needs of various raw materials, semi-finished and finished products, production purposes or basic operational activities. According to forecasts, the current large number of physical workers in material handling will decrease in the future, and at the same time the proportion of highly qualified intellectual workers will increase [2]. Production logistics is the most dominant system of enterprise logistics. The value-creating process can only be performed efficiently if the joints developed on the basis of key strategic issues work flawlessly and optimally as far as possible in connection with purchasing, distribution and recycling logistics [3].

The function of production logistics begins with the entry of materials, commercial and cooperative parts, components, etc. into the production processes (raw material warehouse) and ends with the arrival of finished products at the warehouse (finished goods warehouse) [2].

The generous structure and relationships of the production logistics system are illustrated in Fig. 1.

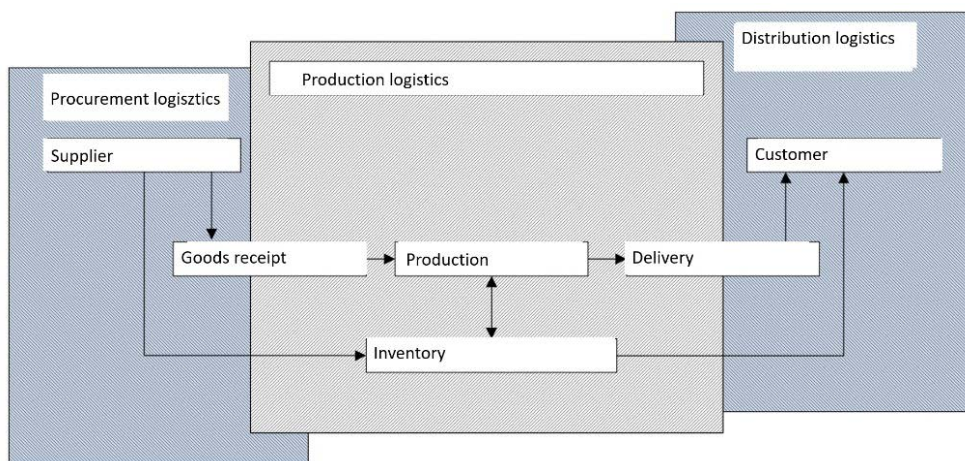


Figure 1. Location of manufacturing logistic [3]

Internal logistics in the narrow sense refers either to a production or service company. In the case of a service company, logistics activities cover healthcare, trade, transport, post, financial institutions, culture, maintenance, etc. [2].

In general, production logistics must ensure a smooth and optimal flow of raw materials from the raw material warehouse through production to the company's finished goods warehouse.

The main objectives of production logistics [3]:

- maximum use of production and logistics capacities,
- ensuring minimum lead times for products and series,
- reduction of changeover times, minimization of inventory levels between operations in the production process (Work in Process - WIP stocks),
- keeping inputs for production and logistics processes to a minimum,
- ensuring the flexibility of the production and logistics system required for the product structure,
- ensuring the transparency of the system, ensuring the traceability of products,
- preservation of the quality of materials and products flowing in the process,
- mitigation of environmental impacts of production and logistics processes, environmentally friendly management and maximum recycling of waste generated,
- adaptation of production logistics to the company's entire logistics controlling system and entire information system.

### **2.1. Material handling machines used in intralogistics**

Continuous material handling machines create a continuous flow of material. Its most important machines: belt conveyors, articulated conveyors, goblet elevator, scraper belts, meadows, pulleys, hanging convectors, shaking dryers, rolling element conveyors.

Intermittent handling machines create an interrupted material flow, operate in work cycles and transport a certain amount of material from the material delivery point to the material drop off point. After dropping off the material, the machine returns to the place of dispatch "empty", unless it is also given a transport task for the return journey. Important batch handling machines: cranes, hanging ski slopes, loaders, high storage rack service machines, manipulators, mobile robots [4].

Among the many different material handling machines, in this paper we will only deal in more detail with mobile robots.

### **2.2. Development of internal logistics with artificial intelligence**

In today's intralogistics systems, where all the internal logistics processes of a site can be found, dynamic information related to the real-time tracking of moving objects has become increasingly important, as this data can be used in solving many optimization problems [5].

AI can also be used for logistical tasks like these. For example, route finding for a task for which Ant Colony (ACO) or Bee Colony Optimization (BCO) can provide a quick and effective solution. Artificial intelligence can be used to make predictions. In logistics, these can be customer order quantities and periods, production capacities, stock levels and stock reservations, or possibly sales data, knowing that you can prepare for the next period and effectively manufacture and deliver. Green manufacturing in smart factories can be supported by AIs, and as some studies have shown, 10-20% utilization of material volumes

and up to 30-50% utilization of equipment can be achieved in transport fleets, for which even MaaS (Mobility as a Service) systems can be used. Both machines such as automated production lines and AGV need to be scheduled to work at the highest utilization rate, and people need to be divided into work schedules and good teams so they can do their work together. Most researchers agree that automation and Industry 4.0 tools not only enable the development of our hardware, but can also automate software and decision-making systems.

The following are manufacturing and internal logistics areas and systems that could be affected by the application of AI [6]:

1. Fully self-driving, operating vehicles on my car
2. Customer demand forecasting
3. Operation of external/internal transport
4. Effective warehouse operation
5. Development of production logistics
6. Effective team building and shift schedule
7. Installation of objects, tools
8. Cybersecurity.

In the case of autonomous mobile robots, artificial intelligence can be of great help by creating better routes and safer traffic in evaluating input data from the machine's sensors.

### **2.3. Industry 4.0 and internal logistics**

In Industry 4.0, all machines are logistically connected in such a way that products can be flexibly transported from one machine to any other machine [1].

The name Industry 4.0 refers to the fourth industrial revolution, by which we mean automated, optimized and fully integrated production processes. Industry 4.0 does not mean throwing away all industrial machinery older than 5 years. There is a technology that can be used to connect analog devices to the gear of the fourth industrial revolution. One of the biggest benefits of the introduction of Industry 4.0 is the optimization of production processes along the entire value chain. Automated logistics using autonomous robots and vehicles adapts to the needs of production [8].

In our view, with the development of factories, significant changes will take place within logistics in the future. Autonomous mobile robots play a major role in internal logistics.

## **3. TYPES OF ROBOTS**

From the following list, it can be seen that robots are now present in all areas of life, thereby changing our daily lives.

Analyzing the sources, we get the following grouping of robots performing logistics tasks currently available on the market:

- Industrial robots: They are used on production lines and warehouses to automate production processes, handle materials and package.
- Warehouse robots: They help you efficiently store and transport products and goods in large warehouses and logistics centers.

- Service robots: Autonomous mobile robots are used in healthcare (e.g. hospitals and nursing homes) to help care for patients and perform tasks
- Agricultural robots: They help with crop monitoring, harvesting and other agricultural tasks, improving productivity and farming efficiency [9].
- Self-driving vehicles: The automotive industry is developing autonomous mobile vehicles that can drive and navigate autonomously, increasing road safety and comfort.

### **3.1. Introducing autonomous mobile robots**

Land-based mobile robots are often referred to as UGV. UGV (Unmanned Ground Vehicles) is defined as a driven, locomotor mobile device with no human crew on board [10].

An automatically controlled, reprogrammable versatile device capable of performing movements with three or more axes. The robot can be fixed or locomotor [11].

Recently, autonomous mobile robots have appeared in many areas of life. Robots can be used effectively to improve the daily activities of companies, hospitals and other institutions.

### **3.2. Automotive use**

AMR with manipulators can assist workers in assembling cars and assemble heavy parts together body at different stages of the assembly line, increasing productivity and quality while reducing worker fatigue [12].

### **3.3. Material handling robots in hospitals**

These robots can support hospital logistics in many tasks, such as collecting garbage from various examination materials from patient care departments and transporting them to appropriate collection points, performing patient transports required by departments and outpatient clinics, moving inpatients. Moving patients in most hospitals is currently done by humans. Properly designed robots are capable of attaching to a bed and transporting patients.

With the right equipment, these robots can also function as remote presence devices in patient rooms or wards, where patients are recovering and resting, so they can observe them remotely if a problem arises, so that they can intervene immediately. In addition to transport tasks, hospitals may also provide services such as room disinfection [12].

Many Western European hospitals like to use robots to transport goods. In Hungary, too, autonomous mobile robots have been in service at Honvéd Hospital for more than a decade to perform certain freight transport tasks. The Honvéd hospital was already built with robots moving around in it, but these were fixed-track AGV robots. By the beginning of the two thousands, these robots were already obsolete, and the decision was made to replace track-based robots with autonomous mobile robots in the hospital.

A SWISSLOG LTC2-FTS (Flexible Transport System) robotic system has been installed in the health centre. This robot is part of a system manufactured by a Swiss company and has been developed to autonomously solve logistics transit tasks in hospitals. The robotic forklifts in the hospital are capable of transporting containers weighing up to

450 kg and have a top speed of 4 km/h. They are able to determine their position using a laser scanner attached to the front and back of the carrier platform. The system consisting of several mobile units is controlled by a central computer, which is able to communicate with mobile units and auxiliary elements on standard Ethernet and WLAN networks [13].

A robot is 1.7 m long, 0.6 m wide, 0.4 m high, weighs 330 kg and is powered by electric motors. It is powered by a 24V 96 Ah NiCd or acid battery. By monitoring the battery level, in case of low battery power, the robot performs automatic docking and resumes its work after charging the batteries [14].

Waste, food, laundry and other necessary items are transported within the facility. The shipment is placed in a stainless steel container and transported by robots to where needed. On seventy-five thousand square kilometers, about twenty-five people are performed daily by a single robot in the Honvéd Hospital [13].

They always show up at the workplace on time, pick up the containers and deliver them to the right destination at the right time, so lunch will not get cold due to logistical problems, patients will be more satisfied with the hospital's service.

#### 4. OVERVIEW OF AUTONOMOUS MOBILE ROBOTS

Autonomous mobile robots are machines that can move autonomously and make decisions in their environment. These robots are usually equipped with various sensors and software that allows them to perceive their environment, understand it, and respond to their current location [12].

##### 4.1. The history of robotics

The name of the robot comes from the Czech word "robota", which means work. The concept of robot became widespread after the publication of Czech playwright Karel Čapek's 1920 tragicomedy Rossum's Universal Robots [4].

History of Robotics: The development of modern robotics began in the 1950s when George Devol invented Unimate, the first industrial robot, which was put into operation at General Motors in 1961. The first material handling robot was installed at GM's Inland Fisher Guide plant in Ewing Township, New Jersey, its task was to lift hot metal pieces out of the injection molding machine and stack them on top of each other, as shown in the picture (Fig. 2). George Devor's most famous invention, the first programmable industrial robot, sparked a revolution in manufacturing that continues to this day [8].

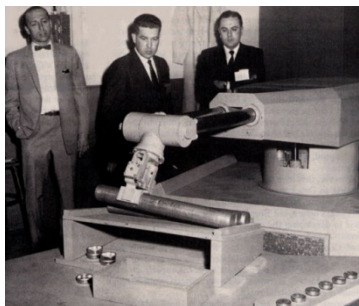


Figure 2. The first industrial robot [8]

The first AGV were developed in the 1950s and were primarily used for material handling in the automotive industry. These early AGV were driven by magnetic tape on the factory floor, and robots followed the tape to move between different locations. In recent decades, material handling technology has developed rapidly. One of the main developments is the development of automated guided vehicles (AGV) into autonomous mobile robots (AMR) [4].

#### **4.2. Basic knowledge of autonomous mobile robots**

A material handling device can be called an autonomous robot if it is able to work independently for a long time without human intervention, can obtain information about its environment and can use it not to harm people around it, property and itself [12].

In order for robots to be able to move and orient themselves in space, several components are needed. Analyzing the literature, the following basic components are absolutely necessary for these vehicles to be considered autonomous vehicles [3]:

- **Sensors:** Sensors play a critical role in robots because they use them to sense their surroundings. They can be visual sensors (cameras), distance sensors (ultrasonic and infrared sensors, LIDAR - Light Detection and Ranging), touch sensors (force and torque sensors), sound sensors (microphones), and many other types of sensors that provide the robot with information about its environment.
- **Actuators:** Actuators are the elements that perform the movement of a robot. These can be electric motors, hydraulic or pneumatic cylindrical motors, piezoelectric devices, etc. Actuators are carried out on the basis of control electronics to perform the desired movement.
- **Control systems:** The control system is the part that coordinates the information coming from the sensors with the actuators' activity. This can be a simple programmable logic controller (PLC), a computer system or even an artificial intelligence system.
- **Power:** Robots need an energy source to operate. This can be electricity (either directly from the mains or from batteries), pneumatic or hydraulic energy, and in some cases various fuels.
- **Software and Algorithms:** The operation of robots depends heavily on their programming. This includes algorithms that make decisions based on sensor data, motion control, execution of tasks, and many other functions.
- **Communication systems:** Many robots can communicate with other devices or systems, such as the cloud, other robots or human users, usually by connecting to a local Wi-Fi network.

#### **4.3. Advantages of using AMR in factories**

There are many benefits to using AMR in industrial environments, including:

1. **Increased efficiency:** Autonomous mobile robots simplify material handling and transport, reducing cycle times.
2. **Cost-effective:** By automating repetitive tasks, AMR reduce labor costs.
3. **Enhanced safety:** Factory robots are equipped with sensors and cameras to safely bypass obstacles and reduce workplace accidents.
4. **Scalability:** Easily upscale or decrease to meet changing production needs.

5. Flexibility: Unlike traditional fixed automation, robots can be reprogrammed for different tasks and routes.
6. Workforce distribution: Freeing human workers from mundane tasks allows them to focus on more complex and value-adding activities.
7. Customizable: They can be equipped with various accessories and integrated with other systems for specific tasks [1, 19].

#### 4.4. Difference between AGV and AMR

AGV (Automatic Guided Vehicles) AMR (Autonomous Mobile Robots) are also most commonly used in internal logistics materials, the difference lies in how they perform this work. The main differences between technologies can be illustrated by the following factors:

- **Automated vs. Autonomous:** AGV follow a fixed path that requires wires, magnetic tapes, QR codes, etc. to orient themselves. If they encounter an obstacle, they must stop and wait until it gets out of their way. AMR, on the other hand, are more versatile and do not require additional infrastructure to orientate, so their installation is hassle-free and very easy to scale. The onboard intelligence of AMR can make decisions when robots face obstacles, replan their route non-stop, and brake safely when someone accidentally gets in their way [14].
- **Migrateable:** AGV requires a marked route, the device can only travel with its backups. This enables the AGV to follow the same route throughout its lifetime, so it can only perform the predetermined transport task. If there is a change in the machine layout or if for some reason it has to take a different route, the robot would have to mark its route again, which is very costly and time-consuming. AMR, on the other hand, can be installed where they are needed, and can be deployed in a completely different location in a few hours [14].
- **User-friendly:** AGV are suitable for repetitive transport tasks, while AMR can provide a wide range of services beyond material handling, such as patrols, cooperation with operators, thus having a wider range of applications [12]. AGV are designed to handle simpler logistics tasks, but are complicated and expensive to deploy. To get started with AMR, it is necessary to map the area, which can be done by the robot walking around the facility itself or uploading the floor plan of the factory to the robot's memory, after which it is only necessary to perform tasks on the intuitive and simple user-friendly interface. It is especially important in factories where smaller, larger changes to the production floor plan and factory layout regularly occur due to a decrease in demand and a possible increase.
- **Business activity:** AGV cannot be flexibly adapted to current customer needs, they are tied to limited infrastructure, if there is a logistical problem that will not change in the future, an automatically controlled vehicle can be a good choice. Based on my experience, agile business is currently the hallmark of most companies, with needs or expectations constantly changing. In a dynamic environment, AMR can flexibly adapt to changing activity problems.
- **Costly vs. cost-effective:** Although an AMR uses much more advanced technology than an AGV, it is usually considered a less expensive solution. Low initial investment and rapid process optimization result in extremely short payback periods, often within a year [14].



- **Technical requirements:** In both versions, the floor should be a flat surface, level differences are not well tolerated by devices due to small wheels. With AMR sensors, these sensors and cameras become clogged, unusable in dusty, humid environments, so the device is unable to orientate.
- **High level of autonomy:** Depending on the equipment, autonomous mobile robots are able to detect obstacles in their path, and by equipping the presence of humans with artificial intelligence by identifying the shape of their feet, they can also avoid obstacles in the way. In the UI, you only need to specify the starting point and end point, the device plans the journey itself. AGV devices also detect that if something gets in their way and they stop, but they cannot avoid it, they can only follow the designated route.
- **Decision-making:** Thanks to the advanced systems of AMR and the ability to navigate independently, they can independently find tasks for themselves. These developments have led to decentralisation of decision-making processes. They can independently communicate and negotiate with others with resources, machines, material flow planning systems, company resources, material handling evaluation and control software, which is very important for Industry 4.0 In a smart factory, devices react dynamically to changes in the state and environment of the system [12].

## 5. ROBOT NAVIGATION

Today's world is unimaginable without GPS, but it can only be used for outdoor tracking tasks. For this reason, various indoor positioning systems have also been developed, so that not only vehicles moving over long distances can be tracked, but also moving objects within sites and buildings can be tracked. Currently, we have several types of systems at our disposal, which differ in reliability, accuracy, operating technologies and other defining properties. In today's intralogistics systems, where all the internal logistics processes of a site can be found, dynamic information related to the real-time tracking of moving objects has become increasingly important, as this data can be used to solve many optimization problems [5].

The automation of driverless vehicles that appear today as a result of Industry 4.0 is a multifaceted and difficult task [24].

There are three basic approaches to positioning. Triangulation, trilateration: The essence is that if we can measure distances from known points or the angle of their location, then the location of the measurement on the plane can be determined if three or more such points are available. The most common measurement methods are distance measurement due to measuring the propagation time of a signal at a known speed, e.g. laser distance measurement. Pattern recognition: With the help of appropriate sensors, we need to measure or detect certain location-based patterns. The patterns can be visible signs, signs, inscriptions are certain features of the building, but they can also be perceived in other ways, such as the signal strength of devices emitting a radio signal (e.g. Wi-Fi, Bluetooth). As a rule, such systems consist of two important modes of operation. The first (or offline) step is to create a map with patterns depending on the location. To collect samples, it is necessary to explore the area where positioning is necessary and collect the values of the property continuously or in places. When localizing (in online mode), you need to look for a pattern similar to the currently detected pattern in the already created sample map

database. After finding similar samples, the current position can be determined based on their location.

**Proximity detection:** In a proximity-based positioning system, markings, signals or beacons are placed in the location area. They can be uniquely identified, their location is known and their proximity can be perceived by a visible image or some kind of broadcast signal. The basis of positioning is what signals and beacons can be detected nearby, and then their identification and known position can be used to determine the detection position [21].

Of course, these solutions can even be combined with each other, thus improving the accuracy and reliability of orientation. Based on my experience, triangulation and trilateration are most often used in the case of autonomous mobile robots.

For the robot to be self-propelled, it must have an efficient detection system and be able to react dynamically to local changes in the environment. Input data is typically provided by a wide range of small, low-budget and energy-efficient sensor technologies. Most commonly used sensors are integrated laser scanners, 3d camera, accelerometer gyroscope [12].

In case of ultrasonic distance measurement, the transmitter emits sound waves: if there is an object in the path of the pulses, some of the waves will be reflected from it, and this echo will be perceived by the receivers. Taking into account its propagation characteristics, the propagation speed and propagation characteristics of the sensor are able to determine whether there is an obstacle in the vicinity of the robot, but it does not provide adequate information about the exact position of the obstacle. This is an older technology, still used in many robots today due to its simple construction, reliable operation and low price [22].

It emits intense, focused pulsed laser energy, then measures the time it takes for the reflected beam to be detected by the sensors, and based on this data, the path traveled by the laser beam can be calculated. LiDAR repeats this process millions of times per second, as these robots travel at the pace of a human walking, providing a very precise long-distance point cloud of their surroundings in real time. LiDAR technology provides a convenient solution for detecting and avoiding obstacles and enables safe navigation in different environments for multiple vehicles [23].

These advanced laser scanners provide a very precise distance point cloud. In general, visual detection of obstacles in all directions is possible only from the area towards which the device is going, supplemented by 3 d cameras [12].

The accelerometer as a sensor measures linear acceleration, which is the rate at which an object's velocity changes. Thus, the accelerometer measures the force during acceleration and from this it is possible to calculate the acceleration of the body. This is a simple and low-cost sensor, but it does not give a high level of accuracy [23].

A gyroscope is a device for measuring angular rotation and angular velocity. The gyroscope is small and cheap, but operates at high speed, so it can follow fast and sudden movements, so it can be used as an addition to the control of leading robots [23].

Most manufacturers use wheels to move devices, but SPOT products developed by several manufacturers, including the most well-known Boston Dynamics, use legs.

Most of the time 4 wheels are used, 2 of the 4 wheels are fixed and 2 steerable, but there are also robots that can rotate all 4 wheels [12].

These robots are able to navigate rooms thanks to precise sensors and powerful on-board computers. A great challenge in robot navigation is that the robot can determine the position of objects in its environment and its own position on this map at the same time.

Thanks to SLAM (Simultaneous Localization and Mapping) technology, these robots can now simultaneously create a map of their surroundings and navigate this map in real time. Thanks to this technology, today's modern robot vacuum cleaners are able to clean the entire area of the room, without SLAM the robot vacuum cleaner would only move randomly around the room [23].

In the past, the spread of self-driving vehicles was also hindered by the lack of adequate energy capacity of batteries. Recently, high-capacity lead-acid batteries have been replaced by lithium-ion batteries, allowing for longer operating times, which is very important since factories usually need to move material twenty-four hours a day. Fuel cells, internal combustion engines can also be used instead of batteries, and renewable energy sources such as solar energy can be used outdoors as an additional solution [12].

These devices are equipped with advanced system software. They are equipped with high-performance processor architectures. The well-applied software enables dynamic route planning and scheduling, navigation and appropriate response to obstacles. The devices plan their own how to get to their destination. [12].

Fig. 3 shows how the robots find their way around.

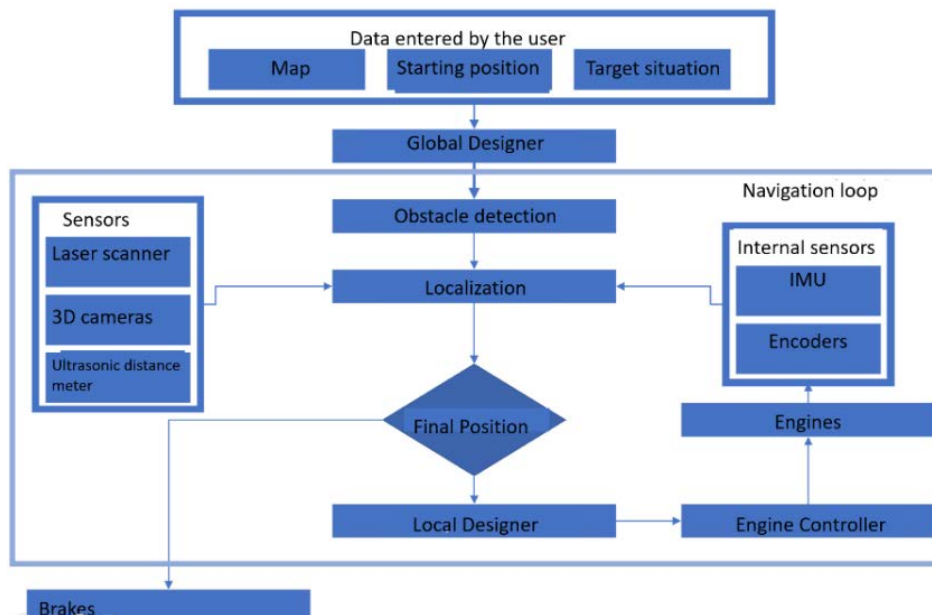


Figure 3. Description of robot navigation system [Own edited].

In order for the robot to find the best route, it is necessary to enter initial data describing where the robot is located, and the person operating the robot needs to specify its destination station, i.e. where the robot should be located in its final position. The user also needs to upload a virtual map to the robot's memory, which shows the obstacles in the room and the exact dimensions of the room. After obtaining all the necessary data to start planning routes, the robot itself plans the route it will travel using the global planning system. A global planning system is an algorithm that generates a route to the desired point, it must be taken into account that it can only bypass those obstacles that are marked on the

map. The planned route is displayed on the map on the dashboard [8]. The local planning system, unlike the global planning system, runs in a continuous cycle throughout the robot's operation. Its task is to react to obstacles in the immediate vicinity of the robot that are detected by sensors and not recorded on a virtual map. Once the obstacle detected by the sensors is detected, the local planner is tasked with determining the route through which the robot can bypass the obstacle. After avoiding the obstacle, it tries to return to the original route created by the global designer. If the robot cannot avoid the obstacle, it tries to signal with light and audible signals that something has got in its way and waits until the obstacle moves [23].

## 6. CONCLUSIONS

When using self-driving robots, the most common problem is that robots get stuck when they encounter unexpected obstacles, such as someone stepping in front of them. They are slow to react to unexpected situations and find it difficult to avoid obstacles in their path. The future goal is to build a system that predicts obstacles in the way of robots. Setting up a fixed camera system on the production line along the robot's route, which continuously monitors the environment and informs the robot of any obstacles in its path, so that the robot can think ahead and replan its route.

It is a solution to the ageing and deteriorating workforce, and in high-production countries, it can be a means of maintaining and growing. Smart manufacturing means integrating artificial intelligence (AI), cloud computing, data science and the Internet of Things into current and future manufacturing technologies. The development of advanced autonomous mobile robots (AMR) is essential to achieve the flexible working environment required for intelligent manufacturing. In my experience, applications in production or production for problematic robots, because they are not yet as advanced, these robots cannot overcome possible obstacles properly and reach their destination later than planned, although problems are usually solved much more slowly than humans in the case of activities that happen regularly, but exact timing to the minute is not required, in which case these robots can be used extremely well. With robots, you can plan ahead more precisely, because we know the capabilities of robots, whereas in the case of humans, everyone performs differently, so the same task may be performed faster by someone who performs it more slowly. They can be used excellently and cost-effectively in repetitive, time-consuming or physically demanding tasks. With the widespread use of artificial intelligence (AI), robots will reach the next level: they will be more efficient, better and able to navigate the environment faster. In this way, they can optimise their route planning and driving behaviour. The disadvantage of these devices is that the mobile robots available today can carry only one ton, while some forklifts can carry up to 30 tons, so they cannot carry all shipments.

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