

PALLET RECOGNITION

Approaches for pallet recognition without machine learning:

		advantages	disadvantages	
Ultrasonic sensors	Can be used to detect the presence or position of an object or measure the distance	<p>Detect objects of various shapes, sizes and materials</p> <p>for non contact detection with low cost</p>	<p>Limited testing distance: limited range</p> <p>innacurate readings: can be affected by atmospheric movements and noise</p>	
Photoelectric sensor	Uses light to detect objects and can be used to detect objects of various shapes, sizes and colors	<p>Longer sensing range than ultrasonic sensors</p> <p>fast response time</p> <p>reliable detection: are not affected by color, gloss or inclination</p> <p>less costly than other types of sensors</p> <p>longer sensing range with fast response</p>	Require separate transmitter and receiver units	
LiDAR	Remote sensing technology that uses a laser light to measure distances and creates 3D models of objects	<p>High accuracy</p> <p>longer sensing range than other types of sensors</p> <p>fast response time</p> <p>reliable detection</p> <p>easy to install</p> <p>long range detection with high</p>	<p>High operating costs in some applications</p> <p>reflectivity limitations</p>	

		accuracy and reliability in harsh environments		
RGBD sensor	Provides both color(RGB) and depth(D) data which can be used for object recognition and detection	High accuracy fast response time reliable detection easy to install flexibility	Limited range susceptibility to interference: external light sources cost complexity	
2D laser rangefinder (LRF)	These sensors emit laser beams that bounce off objects and return to the sensor. The time it takes for the beam to return is used to calculate the distance between the sensor and the object	High accuracy: even in low light conditions: simple wiring and optical axis adjustments fast response time reliable detection easy to install	Limited range: not suitable for detecting objects from a distances susceptibility to interference: external light sources cost complexity	
Hall effect sensors	Contactless magnetic sensors that can detect the strength and direction of a magnetic field produced from a permanent magnet or an electromagnet with its output varying proportion to the strength of the magnetic field being detected	High accuracy: even in low-light conditions fast response time: high speed applications reliable detection: not affected by object color, gloss or inclination easy to install	Requirement of separate magnet for its operation the open collector output is limited to about 20mA or less it may be vulnerable to magnetic fields expensive	
camera	Sensors use cameras to capture images of the environment and then use computer vision algorithms			

	to detect pallets			
Electro-mechanical limit switch	Contains a sensitive micro switch that changes state when a mechanical actuator is displaced by the detected object	CAN BE USED TO DETECT THE PRECISE POSITION OF A MOVING OBJECT		
Pneumatic sensor	Utilize compressed air and a sensitive diaphragm valve to detect the presence of objects. This pressure change is detected by a downstream diaphragm switch that produces an electrical control signal	<p>Inexpensive</p> <p>clean: do not produce any electrical noise or electromagnetic interference</p> <p>safe and easy to operate</p>	<p>Lack precision controls: not high accuracy</p> <p>sensitive to vibrations</p> <p>loud and noisy</p>	
Capacitive sensor	Detect objects by measuring changes in capacitance caused by the presence of an object in their sensing area	<p>Ideal for detecting non metallic objects such as liquids, plastics and powders</p> <p>can detect through containers</p> <p>simple in construction and adjustable</p> <p>lower in cost</p> <p>higher sensitivity</p> <p>good resolution</p>	<p>Sensitive to changes in environmental conditions</p> <p>measurement of capacitance is hard</p> <p>not so accurate compared to an inductive sensor</p>	
Inductive sensor	Detect metallic objects such as screws, bolts and metallic parts	<p>Reliability</p> <p>high sensitivity</p> <p>predictable results and performance</p> <p>can withstand</p>	<p>Limited sensing rangefinder</p> <p>large size</p> <p>expensive</p>	

		harsh environmental conditions		
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