"I / We admit that I/we have read this literature work through my/our observation which has fulfilled the scope and quality in order to be qualified for the conferment of Bachelor Degree in Electrical Engineering (Industry Power)."

Signature : ……..
Supervisor's name I : ……..
Date : ……..

Signature : ……..
Supervisor's name II : ……..
Date : ……

OBJECT RECOGNITION FOR PICK AND PLACE TASKS

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"I admit that this is done by myself except the conclusion and extracts taken from other sources that I explained each in detail."

Signature : ……

Author's Name : LIM HUEY KIAN

Date : 9TH MARCH 2005

This literature piece is dedicated to my beloved mother and father

Appreciation

In this section, I would like to take an opportunity to thank my supervisor, Prof. Dr Marizan Sulaiman, who assist and guide me a lot in executing my project. I would also like to thank Mr. Mohd Ariff Mat Hanafiah, Mr. Mohd Syakrani Akhbar, all my family members and course mates for giving moral supports.

Abstract

The object recognition is a process of making sequences of decisions to gives signal to pick and place system to separate the object. This system are commonly use in industrial field such as manufacturing, automation, fabrication and etc. The conveyor belt is one of the most efficient devices available for moving goods over short distance. The sensor emits, receives, and converts the light energy into an electrical signal. The use of the recognition algorithm as part of the evaluation function for sensing segmentation gives rise to significant improvement of the system performance by automatic generation of recognition strategies. The conveyor system will roll the object and the sensor detects the presence of object and sends the signal to the controller. The controller will distinguish the different objects and instruct the robot arm to pick and place the object to bin 1 (for object A), bin2 (for object B), bin3 (for object C) or bin4 (for object D).

Abstrak

Pengesanan objek adalah proses yang melibatkan satu keputusan untuk memberi isyarat kepada sistem "ambil dan letak" untuk mengasingkan objek. Sistem ini biasa digunakan dalam bidang industri seperti pembuatan, automasi, pembentukan dan sebagainya. Alat pengangkut adalah peranti yang paling cekap dan mudah diperoleh untuk menggerakkan barang-barang dalam jarak yang agak jauh. Fungsi penderia (alat pengesan) melibatkan proses memancar, menerima dan menukar tenaga cahaya kepada bentuk isyarat elektrik. Algoritma pengesan digunakan sebagai sebahagian daripada fungsi penilaian bagi pembahagian pengesan untuk memberi peningkatan kecekapan yang ketara dalam sesebuah sistem dengan mengaplikasikan strategi-strategi penjanaan pengesanan secara automatik. Sistem pengangkut akan membawa objek dan penderia pula akan mengesan objek dan menghantar isyarat kepada pengawal. Alat pengawal akan menilai perbezaan objek dan mengarahkan lengan robot untuk mengambil dan meletakkan objek ke dalam bin 1(bagi objek A), bin 2(bagi objek B), bin 3(bagi objek C) atau bin 4(bagi objek D).

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Chapter 1

INTRODUCTION

In the field of industrial robotics, many different calibration methods exist to help reduce error in the robot system. One of the most common calibration methods, locating the manipulator home position, requires that the robot be positioned with all joint angles specified to have a value of either zero or 90 degrees [1].

To improve the calibration of the home position, first wanted to simplify the method of calibration. The home position can be found using one of the following three separate methods of calibration [2].

i. Relative calibration - Expensive process that requires each component in the robotic structure to be defined relative to the previous component. Accuracy from relative calibrations can vary based on the accuracy of the robot components.
ii. Optimal calibration - This process uses a measurement system combined with kinematics models of the robot to measure many positions of the robot and correct any errors present in structure. Accuracy from optimal calibrations can vary based on the robot positions and kinematics model.

iii. Leveling based calibration - Process uses simple electronic levels known as inclinometers to easily orient each component of the robot structure with respect to the angle read by the inclinometer.

To improve the initial device, the prototype was reduced to a single right angle plate with the two sensors mounted perpendicular to each other within the structure. Operation of the calibration procedure was also improved with automated software to adjust the position of the robot joints to match the values required by the sensor values [3].

Chapter 2

LITERATURE REVIEW

2.1 TYPE OF SENSORS

There are many type of sensor used in new technology system. This is because their ability beyond convention switching devices. Sensors are divided into many categories based on their input parameters such as inductive proximity sensor, capacitive proximity sensor, photo sensor, magnetic sensor and etc. In my project, four types of sensor are used, such as the inductive proximity sensor, capacitive proximity sensor, photo sensor and magnetic sensor. The functions and more details of these sensors will be further explained according to subtitle below.

2.1.1 Inductive Proximity Switches

A proximity switch is a device *(refer to Figure 2.1)*, which causes a switching action without physical contact. Inductive proximity switches only react to metal material up to an operating distance of approximately 50 mm. Proximity switches respond to targets that come within the active range of their generated sensing fields. These units are completely self-contained, and house a field generator, amplifier, and other necessary circuitry to accomplish electronic switching.

The units are all solid state and have no moving parts that can wear out. The electronic switches are not susceptible to contact contamination, contact erosion, or material transfers are mechanical switches. Their service life, within their specified ratings, is virtually unlimited. The switching is insensitive to vibration, and is positive (full step function) without chatter, regardless of how slowly the target approaches or recedes from the sensor.

The oscillator resonant circuit, located in the proximity switch, uses an open core coil to help produce a concentrated high frequency electro-magnetic (RF) field, which emerges from the active surface of the sensor. If a metal target (e.g. metal) enters this field, eddy currents are induced. The floating induced eddy current draws energy from the LC circuit (L : coil, C : capacitor). The load on the oscillator circuit evokes a decrease in the oscillating amplitude. The oscillator is attenuated.

The decrease of the oscillating amplitude is converted into an electrical signal by the electronic circuit, which leads to a change of switching state of the proximity switch. When the electric conductive material is removed from the inductive field, the pulse amplitude increases and via the electronic circuit the original switching position is recreated [6].

Figure 2.1: Inductive Proximity Switches

2.1.1.1 Standard Barrel Types

Housings of standard inductive ranges are made of Nickel coated brass barrels *(refer Figure 2.2)*. They are widely used in non-corrosive atmospheres.

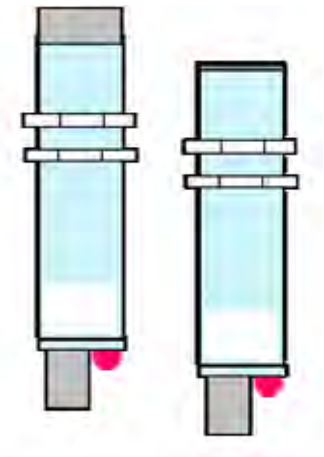

Figure 2.2: Housings of standard inductive

2.1.1.2 Operation

The oscillator creates high frequency electromagnetic field, which radiates from sensing face of the sensor. When damped with metallic object, eddy currents are induced in metal causing change in amplitude of oscillations. This signal is conditioned to change Schmitt trigger output and state of output amplifier. Analogue DC output voltage and current are available in addition to standard PNP/NPN switching outputs. Figure 2.3 shows the principle of inductive proximity switch operation [6].

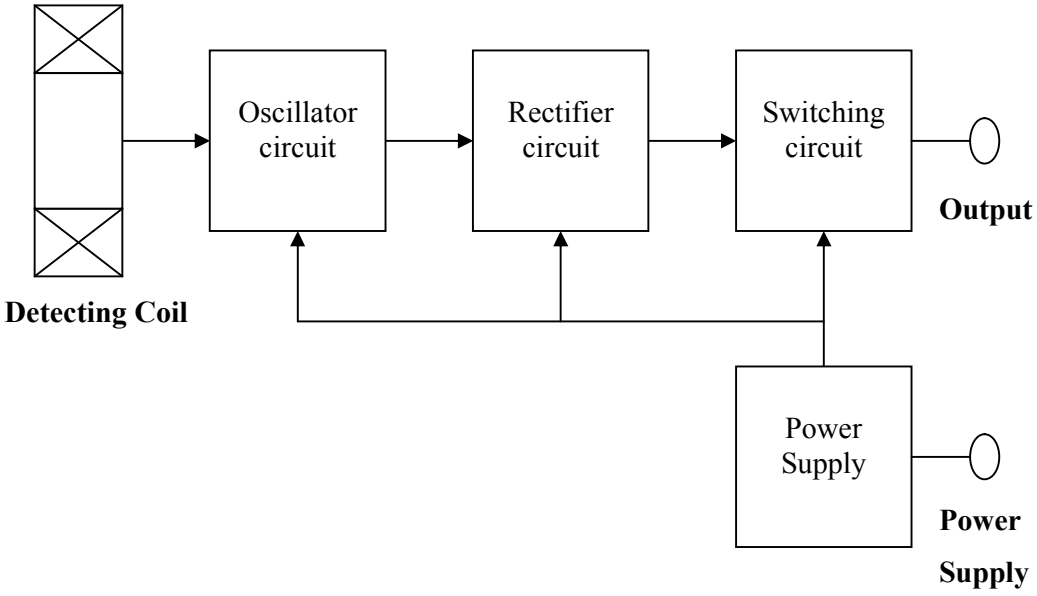

Figure 2.3: Block diagram of the operation principle of inductive proximity sensor

2.1.1.3 Advantages of inductive proximity switches

The advantages of inductive proximity switches are:

i. High reliability with frequent or rare switching processes, there are no contact bouncing or contact wear
ii. Contact less function; therefore no influence of the material surface
iii. High switching speeds up to 5000 Hz
iv. Large contamination insensitivity in relation to non-metallic contamination, e.g. dust, oil or aqueous/organic solvents
v. Small current consumption
vi. Cheap

2.1.2 Capacitive Proximity Sensors

Capacitive switches *(refer Figure 2.4)* can also detect non-metallic materials, but only over relatively short operating distances. Capacitive proximity switches are contactlessly working position switches, which react to the presence of objects of nearly any materials within the supervised range. Capacitive proximity switches operate using an RC resonant circuit (resistor-capacitor), where the capacity is affected. To achieve this, the electrodes of the capacitor are separated. One electrode is located in the proximity switch on the active surface. The second electrode is either the target with earth or ground as return line, or ground itself, whereby the target causes a change in the dielectric medium.

When this medium approaches the active surface and thus the capacitor electrode in the sensor, capacitance increases to the extent where, with the resistor, the value for tripping the resonant circuit is reached and the oscillator starts oscillating.

When the actuating target is removed from the active surface, the opposite occurs, and the oscillator stops oscillating. Commencement and ceasing of oscillation, evaluated by the connected electronic circuitry, produces a change in the switching state of the proximity switch. A built-in potentiometer permits fine adjustment of the actuating distance within the field. The sensor responds to all solid and liquid media, such as water, glass, wood, paper, metal, plastic, foodstuff, etc. Figure 2.5 shows the principle of capacitive proximity switch operation [6].

Figure 2.4: Capacitive Proximity Switches

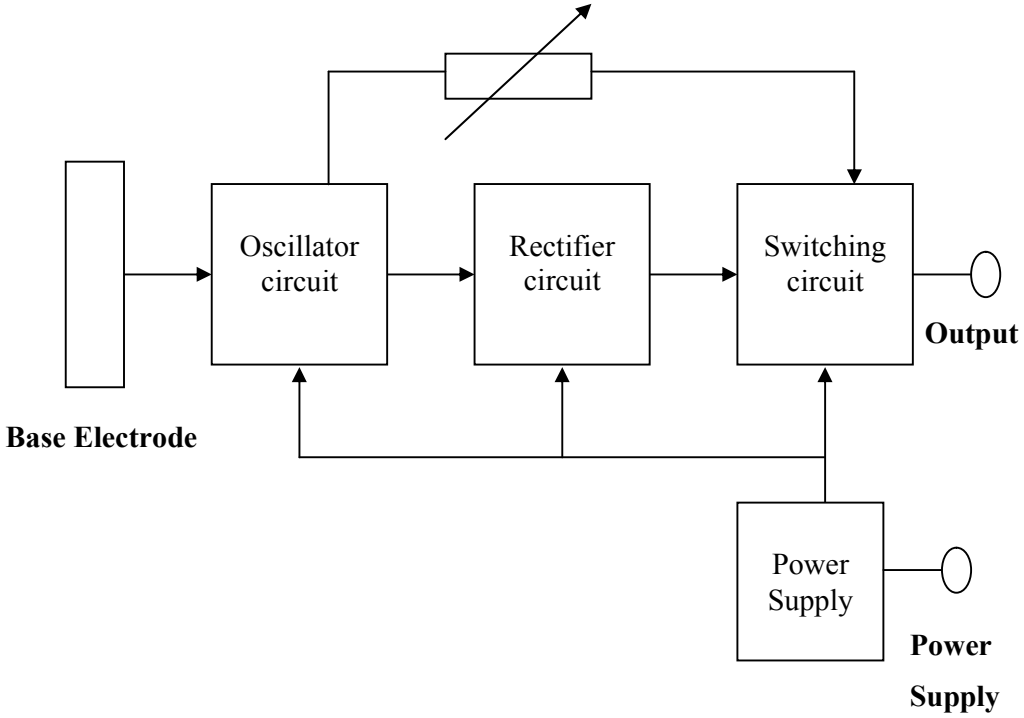

Figure 2.5: Block diagram of the operation principle of capacitive proximity sensor

2.1.3 Photoelectric Proximity Switches

The IFO photoelectric switches are non-contact switches, which are suitable for use as a diffuse-reflective sensor (without reflector) or as a retro-reflective sensor (with reflector). Light emitter, receiver, electronic evaluation circuitry and amplifier for AC or DC are all in one common housing (self-contained type). No additional power supply, switching units or amplifiers are necessary. The operating principle is based on modulated light, which is emitted through the front lens of the switch directly to the object or reflector, which is to be detected. The reflected light reaches the receiver through a second lens, and is processed electronically, causing a change in the output condition of the switch. Removal of the object from the detection zone causes the switch to return to its original switching position. Due to the synchronization of emitter and receiver circuitry, the photoelectric switch is insensitive against interference and external light.

Photoelectric switches *(refer Figure 2.6)* can only detect objects, which reflect sufficient light. Therefore, the operating distance depends a lot on the surface condition (reflectivity) of the object to be detected. A smooth white surface allows for a much larger operating distance compared to a dull black surface finish. With some models, the optimum operating distance for each application can be set, using the built-in potentiometer. In this way, undesired background reflections are eliminated. The provided LED is also helpful when setting the sensing distance, as it shows switching condition and is used as a function indicator. It is further possible to choose between light operation (ON with reflection, corresponding to NO contact) and dark operation (OFF with reflection, corresponding to NC contact) by repositioning a small jumper at the terminal screws [6].

Figure 2.6: Photoelectric Proximity Switches