INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 5, Issue 2)
Available online at: www.ijariit.com

Configuration of anti-collision system for stacker and reclaimer

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ABSTRACT

This Paper deals with the solution for collision detection in the area of industrial machines. Now a day's, the world is focusing to improve the industries with automation. In order for the automation, the requirement of workers will decrease and time-consuming to do the job is also decrease but protecting the device from collision becomes difficult because sometimes we require more than one system to complete the work in small areas. In these situations, there will be a collision between those machines. Due to this collision, devices can cause damage to the equipment's as well as the workers in that field. Thus collision detection and collision avoidance are very important so that we provide the anti-collision solution. In this paper, we describe the theoretical introduction, practical solution and also real application.

Keywords— *Anti-collision, Stacker and Reclaimer, Radar, Radio modems, Controller*

1. INTRODUCTION

This system presents the anti-collision system for several moving and rotary cranes with interfering working see figure 1. The goal is to protect the moving stacker and reclaimer from collision while operating the machines individually from different cabins or different wireless remote control systems.

Here the stacker and reclaimer are connected through a conveyer belt. The conveyer belt lied on the stacker and reclaimer tracks. The two machine tracks are different.

Basically, the stacker machine is used to dump the material coming from reclaimer through the conveyer belt. The stacker moves right or left while dumping the material because the material meets the height of the machine so It has to move the whole machine right or left to dump the material and it moves its dumping material hand horizontally and vertically.

The reclaimer dredging the material in the field so it supposed to move from one place to other to dredge the material from different places in the fields. While moving these machines the cabin controllers also don't know the other machine motions and sometime they start the machine they leave, that times also the collision will happen in-between those machines. We give the anti-collision solution to his problem.

Fig. 1: Stacker and Reclaimer machines

2. ANTI-COLLISION

The anti-collision system is a safety device to avoid collision between the moving machines. The main principle of the anti-collision is sharing the 3D coordinates of the machine from one machine to another machine. For knowing the 3D coordinates of another machine we use Radar and sensors the equipments are used for the Anti-Collision are a) Radar, b) Antenna, c) Radio, d) Controller using these we provide the complete solution for anti-collision.

2.1 Radar

Radar is a device which is used to for measuring the distance of object and position of the object. By sending the electromagnetic signals from radar to the object and these electromagnetic signals reach the object and reflected back to the radar using the velocity of the signal and time taken by the signal to reach back to the radar using these two parapets we can know the distance of the object.

The basic principle and concept of radar operation are simple and clear to understand. A radar system delivers electromagnetic energy and examines the energy reflected back to it (by an object). The theory and purpose behind radar, on the other hand, is very complex. The clear prospect of the theory is essential and necessary in order to be able to specify and design radar systems accurately. The electromagnetic waves are

reflected if they come together with an electrically leading surface. If these reflected waves are received again at the position of their origin, then that conveys an obstacle is in the propagation direction Distance Measurement Unit (LWDMU) uses the principle of radio to measure the distance between two objects. The propagation of the speed signal is equivalent to the speed of light (300,000km/sec). The distance is calculated based on the time of flight between the sender and the receiver. The update time of the data is as close as to less than a Nano sec. Anti-collision functionality between machines shall be provided by the display of real-time distances and alarms to enable the machine operator to take appropriate action manually. Anti-collision protection will enable both the machines to stop at safe distances given during the time of erection and the distance between both the stacker and reclaimer will be measured and displayed at HMI for ease of operator.

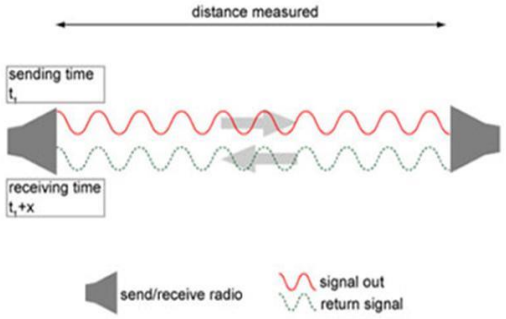

Fig. 2: Physical Radar Distance Measurement

2.2 Antenna

An antenna is the crossing point between radio waves propagating through space and electric currents moving in metal conductors, used with a transmitter or receiver. In transmission, it clearly illustrates that radio transmitter provides an electric current to the antenna's terminals, and the antenna radiates the energy which is enhanced from the current as electromagnetic waves (radio waves). During the reception, an antenna diverts some of the power of a radio wave in order to produce an electric current along with its terminals that is applied to a receiver which is to be amplified. Antennas are vitally important components of all radio equipment.

2.3 Radio Modem

Radio modems encode, transmit, receive and decode serial data with the help of radio waves. It connects to serial ports on devices, for example, video cameras and data acquisition systems, and send necessity signals to and receive signals from different radio modems. Even though these type of radio modems no need of wires, their applications may be limited by uneven terrain, inadequate antenna heights, and antenna feeder cable loss. In this type of situations, a radio modem repeater may be required.

2.4 Controller

A Programmable Logic Controller (PLC) is a specialized and functional computer which is used to control machines and processes. Therefore, it shares common terms with typical PCs like a central processing unit, memory, software, and communications. Incompatible a personal computer through the PLC is constructed to survive in a rugged industrial atmosphere and to be very flexible and compatible in how it interfaces with inputs and outputs to the real world.

We need to write the code for the controller to execute these all function the software interfacing of the controller is mentioned below.

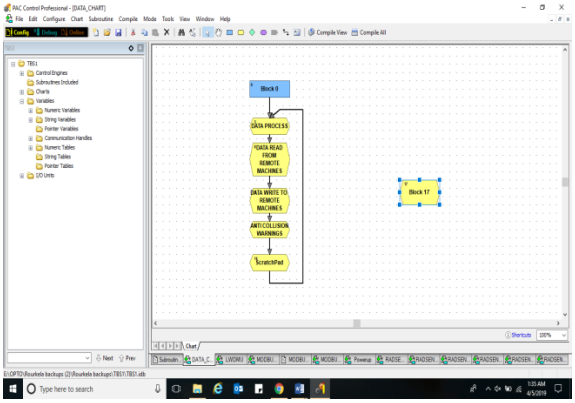

Fig. 3: Controller interface layout

In each block, we wrote the corresponding code to execute the program.

2.5 Schematic diagram for anti-collision

Find the above Schematic diagram for one stacker and one reclaimed machine they both move individually so to avoid the collision we are giving anti- Collision wirelessly.

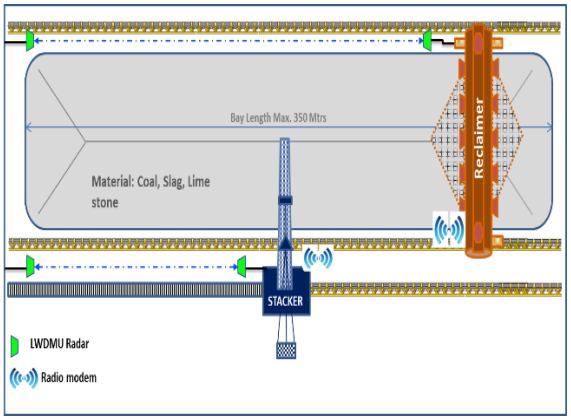

Fig. 4: Schematic diagram for anti-collision

In the above stacker reclaimer machine, the ends of the yard are taken into consideration and every end has left the side and right side so we connect one radar at stacker machine and another radar is connected at one end of the yard and that Radar should be a line of sight with the stacker radar. Like same wise connect the one radar to the reclaimer machine and another radar is connected one end of the yard and it should be in the line of sight with reclaimer machine radar.

For transferring the data of one machine to another machine we connect one radio to each machine the data from one radio is transferred through the radio and another machine radio modem receive the data and it sent to the controller

3. THE GENERAL ARRANGEMENT AT THE MACHINE

For Limestone yard one controller is connected at stacker and another controller is connected at reclaimer, the radio modem and the radar and luff and slew sensors gateway all are connected to the controller.

It takes the data from all the equipment connected to the controller and it processes the data and transmits to the other controller through the radio modems. And another controller also processes the data and transmits to the data through its radio modem

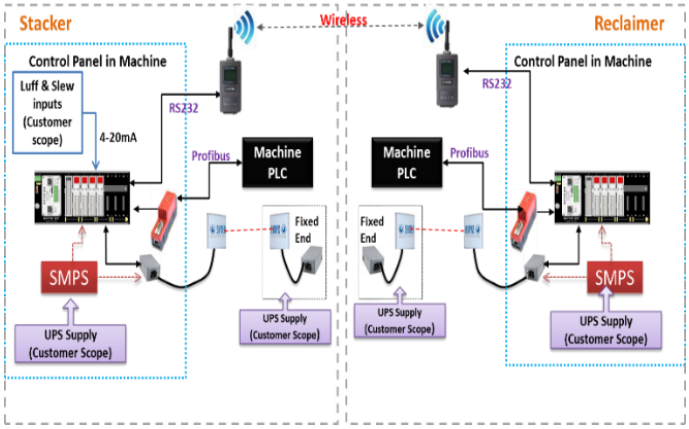

Fig. 5: General arrangement at machine

The distance measurement should be done in the figure shown in figure 4 and figure 5.

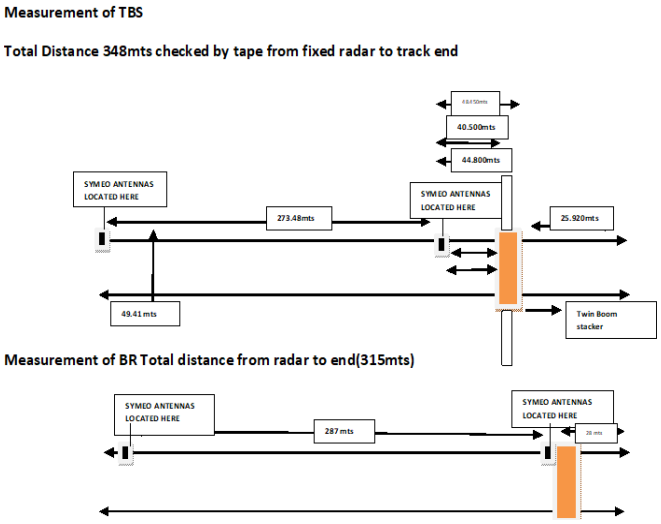

Fig. 6: Calibration of distance in radar

Distance measuring the moving machine to the fixed end. first, we measure the distance with tape then we calibrate that distance in radar software

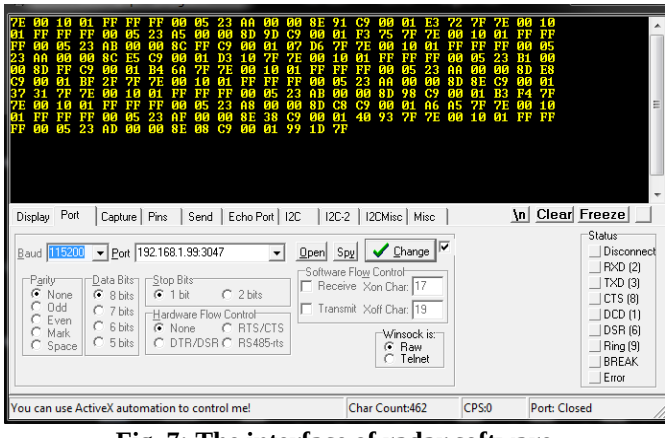

Fig. 7: The interface of radar software

This the radar software to find the distance between the radar and the data received should be in hexadecimal and that data is clearly shown in the figure 6.

The data from the radar is 14 bits of hexa decimal data that data is transferred to the controller, it extracts the bits from that total 14 bits. The controller takes the 8,9,10,11 bits from the total frame received from the radar and it will do modifications and sent that data to radio modem then this radio modem transmits the data to another radio modems and that data goes to the controller then that controller will do the subtraction of the distances.

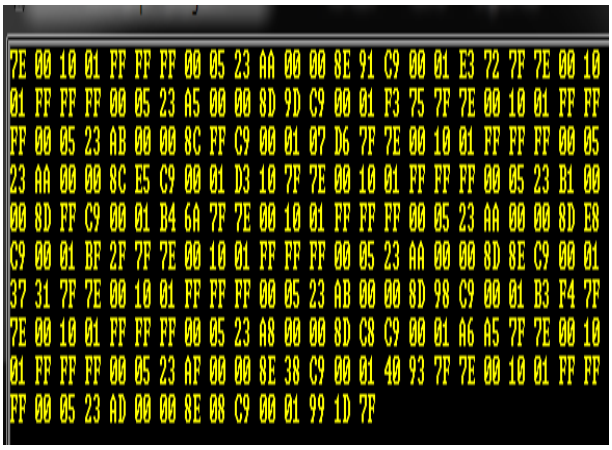

Fig. 8: Received radar data in software

So using that distance that compares the minimum distance what we mentioned in the program if the distance is less it will slow or stop the train and if the distance is more than the minimum distance then it will move in what direction it is moving

4. DIFFERENT RADAR'S AND THEIR FUTURES

We can use any radar based on the application and the requirements. We placed the different types of radars to measure the accurate distance and we got the results for the different radar outputs and placed in the below-provided table. We use the radar based on the application we need an accurate we need and frequency band based on these parameters we can use any of the radar.

Table 1: Different type of radar's

Product	LPR®-1D	LPR-1DXi	LPR-1DHP	LPR-1DHP-R	LPR-1DHP-220-R	LPR-1DHP-260
Accuracy	+/- 5 cm *	+/- 10 cm *	+/- 1 cm *	+/- 1 cm *	+/- 0.5 cm **	+/- 0.5 cm **
Measurement principle	Pair wise	Pair wise	Pair wise	Reflector	Reflector	Pair wise
Frequency	5.8 GHz	5.8 GHz	61 GHz	57 - 64 GHz	57 - 64 GHz	24 GHz

5. CONCLUSION

In this paper, we provided the anti-collision solution for stacker and reclaimer machines. We provide the solution using these radar's and the transmitting signals from radar and opposite side also we kept the radar basically we can keep normal reflector, it also reflects the signals but we are not even used these reflectors because these reflectors made up of some metals so normally in industries so many metal equipments will come in between the radar and reflector in that situation we will get false data so to avoid that situations we used both side radar's only due to this we can avoid the collisions efficiently.

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