THE YARD SIDE APPROACH FOR A SMART HARBOUR

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ABSTRACT

There are many maritime container terminals found all around the world. The performance and the efficiency of such container terminals depends on how well the containers are handled by the quay cranes, yard cranes and the yard trucks which are employed inside the harbours. There are two common approaches for dealing with the harbours, one is the quay side approach and the other one is the yard side approach. This paper deals with the yard side approach which involves yard cranes optimization, RF ID process and the ship balancing.

Keywords: Smart Harbour, Yard Side Approach, Container Terminal, Logistics, Yard Allocation Algorithm

I. INTRODUCTION

In a container terminal there are three most important things which are found. Those are: quay cranes QC (which is used to unload the containers from the ship),yard cranes YC (which is used to unload the container from the truck into the storage yard) , yard trucks YT (which are used to take the containers from quay side to the storage yard).[3]

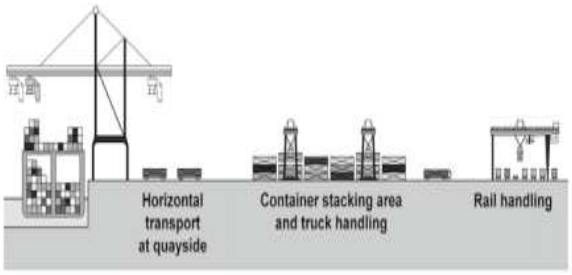

Fig 1:Container Terminal Operation

Fig 1 shows the exact operations at the container terminal. The sea side is called the quay side and the storage side is called the yard side. As soon as the ship arrives it is the duty of the quay cranes to serve the ships and unload the containers within the specified time. There are few cranes which are present inside the ships for emergency operations. The derick cranes are those which are fixed and are used to carry heavy containers[7]. These cranes can move a very small distance so as to cover the entire ship. Few cranes are movable and are used when needed.

Once the containers are unloaded then it is the duty of the yard trucks to serve the cranes immediately. The trucks are allocated based on the weight of the containers. The containers are measured in terms of TEU (twenty foot equivalent units) so depending on this the trucks are allocated manually to serve the cranes[6]. Once the

containers are loaded into the trucks the plan will be given to the drivers which tells them as which yard to go and store the containers.

The truck will move to the needed yard as per the plan and the yard crane will be present to unload the containers from the truck to the yard. The containers will be stacked one above the other. So by this way the containers are unloaded from the ship and are loaded into the yard side. The vice versa operation will take place loading the shipalso.

II.YARD SIDE APPROACH: YARD CRANE OPTIMIZATION

The yard serves as a buffer for loading, unloading and transhipping containers.The yard is separated into blocks. The position of the containerinside a block is identified by bay, row and tier [4]. In order to optimize the yard cranes the:

1. policies are followed for groups of containers at block and bay level:

- To make a balanced workload among blocks
- To reduce the total distance covered to move containers from quay to yard.

2.Re-marshalling of containers are made according tothe ship loading plan,to:

- Speed-up loading operations and the unloading operation.

3. Yard cranes deployment involves allocation of cranes among blocks, routing andscheduling of operations,to:

- Minimize the time taken to complete a job.

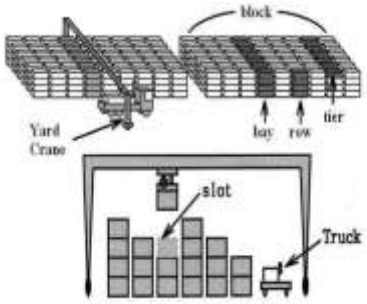

Fig 2: Yard Crane Operation

The yard shown in the fig 2 is usually the bottleneck of the terminal.Traffic, congestion and capacity issues originate from here. Main issue: the "schedule" of the outgoing flow is unknown to the terminal.The two types of the yard management terminals are

1. Import/export terminals: yard management is strictly connectedto gate operations (trucks and trains).
2. Transhipment terminals: yard management is strictlyconnected to mother vessels and feeders.

III. RFID

RFID stands for radio frequency identification here the RFID is used as a card for the truck drivers to know the yard position as well as the availability [5].There are three types of RFID tags one is the Passive tag that uses the reader field as a source of energy for the chip and for Communication from and to the reader. The power which is available from the reader field, reduces very rapidly with distance and is also controlled by strict regulations. This results in a restriction in the communication distance of 4-5 m when the UHF frequency band is used which is of the range 860 MHz – 930 MHz. Semi-Passivetags which are also called as the battery assisted backscatter tags have built in batteries. This implies that they do not require energy from the reader field

to power the chip. This is an advantage, because this allows them to function with lower signal power levels, which results in a greater distances of up to 100 m. Active tags are battery-powered devices that have an active transmitter. Unlike passive tags, active tags generate RF energy and apply it to the antenna. The coverage distance is more, but it is much costlier compared to the other two.

Fig 3: Flow of the RFID Process

The flow of the RF ID process is shown in the fig 3. The container terminals will have many lanes through which the yard trucks enter inside the terminal. Here in this method by using the RF IDs which are provided to the truck drivers the task becomes easier. The exporters who take away the containers from the yard are provided with extra facility of booking the slot or the lane they are in need of so that they can take that particular lane n carry away the containers with ease. Once the trucks arrive near the gate the validation of the tags are made then depending on the information in the tag the drivers are directed to the needed yards.

IV. VESSEL BALANCING

In any maritime container terminal the most important issue is balancing the ship or the vessel. Balancing the ship means that when the containers are being unloaded form the ship care should be taken in order to remove the containers in an orderly manner so that the ship does not sink or get imbalanced. So, to maintain this balanced, the hatch plan must be made and it has to be given to the crane operator so that he is aware of the weights of the containers and thus he removes the containers in the mentioned manner thus reducing the loss caused by imbalance of the ship.

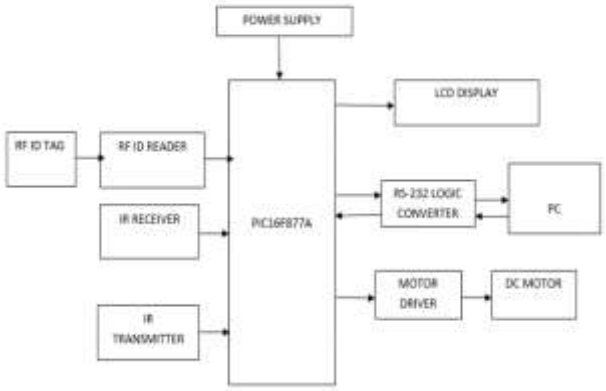

Fig 4: Block Diagram of the System

V. BLOCK DIAGRAM OF THE PROPOSED SYSTEM EMBEDDED CONTROLLER

Fig 4 shows the block diagram of the system which depicts the yard side approach. The embedded controller is preferred because of its software and industrial advantages in power electronics like built in ADC, DAC, ROM, RAM, USART. This leads to lesser space occupation by the circuit and also the speed of embedded controllers are more compared to other processors. The embedded controller which is chosen here is PIC16F877A due to its

various features. Peripheral Interface Controller (PIC) is enhanced version of microcontrollers. It has a high-performance RISC (Reduced Instruction Set Controller) CPU. Only 35 single word instructions are present. All are single cycle instructions except for program branches which are two cycle. It has 4K x 14 words of Program Memory (EPROM), 256 x 8 bytes of Data Memory (RAM), Interrupt capability (up to 14 internal/external interrupt sources), eight level deep hardware stack,12-bit multi-channel ADC,Universal Synchronous Asynchronous (USART) Receiver and USART Transmitter.

5.1 DC Motor

A DC motor relies on the fact that like poles repel and unlike poles attract each other. It has a coil of wire through which the current runs and that generates an electromagnetic field which is aligned with the centre of the coil. A simple DC motor typically has a set of magnets in the stator and an armature with a series of two or more windings of wire wrapped in insulated stack slots around iron pole pieces with the ends of the wires terminating on a commutator. The total amount of current sent to the coil, the size of the coil and the wrapped material dictate the strength of the electromagnetic field. By turning on and off coils in sequence a rotating magnetic field can be created. To create a force on the armature which causes the motor to rotate,the rotating magnetic fields interact with the magnetic fields of the magnets (permanent or electromagnets). At high power levels, DC motors are always cooled using air that is forced inside.

5.2 Infrared Transmitter and Receiver

IR Transmitter has a simple and clear infrared LED on it. The Infrared LED which is present operates at around 940nm and work well for generic IR systems including remote control and touch-less object sensing. IR receiver has an IR detector mounted on it.IR detector has little microchips with a photocell each. They are almost always used for remote control detection.

5.3 LCD

A liquid-crystal display (LCD) is a flat panel display that uses the light modulating properties of liquid crystals. The crystals which are used here do not emit light directly. LCDs are available to display images as in a general-purpose computer display or fixed images which can be displayed or hidden. The arbitrary images are made up of a large number of small pixel this concept is used. Here the LCD is used to display the information about the yard as well as the quay cranes.

VI.RESULTS AND DISCUSSION

Fig 5: Indicates how the Selection of the Database is Made

There may be many ships which arrive at the particular harbour at a time so now in order to choose which ship is arriving and to schedule accordingly this selection of the database is done which is shown in fig 5.

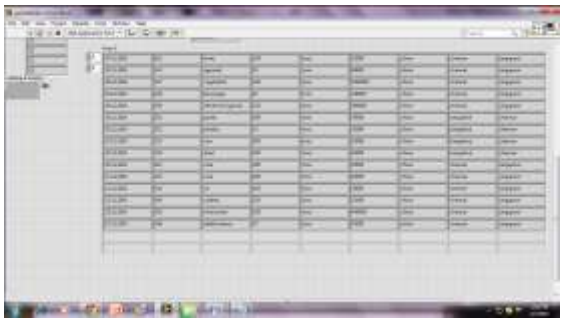

Fig 6: Shows how the Containers are Allotted Based on the Insertion Sort

Here, one the selection of the database is made then the insertion sorting algorithm which is used sorts the containers accordingly and helps in reducing the time taken for dumping materials at the yard.

Fig 7: The Smart Harbour Demo Kit

Fig 8: Performance Chart

The Entire Performance of This Smart Harbour is Tested Using the kit shown in the fig 7 which proves to be efficient if implemented in real time scenarios. The performance analysis shown in the fig 8 is made between the real time and the simulation pattern and thus the result concluded was the smart harbour provides efficient results compared to the present existing harbours.

VII.CONCLUSION AND FUTURE WORK

The yard side approach dealt in this paper seems to be an efficient one compared to the traditional approach. The methods proposed in this paper has reduced the congestion and miscommunication caused in and around the harbours. The extension of this can be any new innovations that can further reduce the issues. This paper can also be extended considering an integrated approach of both the quay and the yard side approaches.

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