Container movement tracking without installation of tracking device

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Abstract- **The Shipping Industry has a huge impact on the world economy and containers play a major role in that. Today millions of containers are moved in / out of ports. Tracking them has always been a challenge for Shipping Lines. Many solutions are proposed that use different ways / means to track container movement by installing devices on the containers. All existing solutions are too complicated and expensive for shipping lines to implement it on containers. Certain countries have imposed restrictions on installation of any type of Tracking Device on Containers. There isn't any system that can track and store the movement of containers across globally. Rather than tracking the container via a device, this paper is to propose tracking of the container movement at certain checkpoints using camera recognition without installing any device on the container. This study is about the pros and cons of existing systems versus the pros and cons of proposed systems with cost analysis and implementation challenges across the globe.**
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I. INTRODUCTION

Containers are the second most valuable asset of a Shipping Line after Vessels. Tracking them has always been the major concern for the Shipping Lines. When a container is on a ship, it's tracked by the Port Operators and Vessel Owners, but when a container is unloaded from ship and is transported on land it becomes a challenge to track it. "ISO 6346:1995 provides a system for general application for the identification and presentation of information about freight containers. Specifies an identification system with mandatory marks for visual interpretation and optional features for automatic identification and electronic data interchange and a coding system for data on container size and type." (Technical Committee: ISO/TC 104/SC 4 Identification and communication 1995) A container can be recognized as unique by its Container No & Size-Type ISO Code across the world. Container No is coded in ISO 6346 format, which is an international standard which is used by shipping lines to identify their containers.

An example of container no is (CSQU3054383). The first three letters CSQ are owner code, which indicates the principal owner of the container.

The fourth letter U is used for equipment category identifiers. Other possible examples are the next 6 digits 305438 is the container serial number which is assigned by the owner which is used to uniquely identify the container in their inventory.

The last digit 3 is called a check digit. It is a computation digit which is generated by calculating (owner code, category code and serial no).

Not all containers follow ISO 6346 standard, usually these are private containers owned by non-vessel operators / shipping lines. Since the ISO 6346 standard was introduced in International Customs conventions (Customs Conventions on Containers and Istanbul Convention), many countries have started validating the container as the ISO standard.

Apart from the container no, its size and type is also defined by size code (22G1).

The first character represents the Length of the container.

Second character represents the width and height of the container.

Third and fourth character represents the category of the container.

2 – 20 feet

2 – 8 feet 6 inches

G1 – General Purpose

there are certain other markings on container which represents the following information

1. The weight of the container. Tare Weight, Loaded Weight and Gross Weight
2. Height markings for containers taller than General Height of 8 feet and 6 inches.
3. If the container is used for Hazardous Cargo.
4. There are existing system that uses optical recognition to read container No.

II. PROBLEM

This idea was incubated when a particular Shipping Line requested for a solution where no devices can be installed on containers, as in certain countries, tracking devices on containers are prohibited. Also attaching a type of identification requires some manpower and time, Installation of any type of identification in form of a device or RFID Tag on a container is time consuming. A database also needs to be updated when attaching external identification marks that match the container no on which it is installed. That list needs to be updated on a regular interval whenever a device is replaced / removed. Hence tracking with the camera is the only solution by which we can achieve the desired result. Since they are always on the move, it becomes very challenging to install a device on the container.

Today our lives are surrounded by many cameras. They are installed at different points for Security Purpose, Gates, Toll Booths, Container Freight Station, Empty Yards. Using the existing camera feed we can recognize the container no and send the information on cloud about the location.

With new innovations and research happening in optical and camera designing, and with the availability of smaller form factor powerful and cheaper boards like the one used in Mobile Phones. It will be cheaper to develop and implement this type of tracking. One of the major aims is to generate minimal data, mostly one packet per camera location, as compared to devices that keep sending packets at regular intervals. Aim is to track the container when it crosses checkpoints.

Optical Character Recognition has improved a lot in past years with 99% accuracy. Using the live camera feed, we can detect and recognize container number along with Geospatial data and timestamp and send it to a distributed system, which can later be used to tracking, analyze the container movement.

III. PROBLEMS IN EXISTING SYSTEM

There are various companies which are working on a device based solution that can be installed on a container to track muck like a GPS system in a Car. The device has a GPS antenna installed which can capture GPS Packet from Satellite.

There are two types of system available currently.
1. RFID Tags
2. External Devices with GPS / WIFI

The problem starts when a device is installed on a container.
1. Maintain a Device Identification Database
2. Means of Communication
3. Battery Operated Device
4. Countries with Restriction
5. Theft of the Device itself

IV. PROPOSED SOLUTION

The proposed solution is to track without installation of any sort of identification devices / tags. As the container no itself is identified by unique container no, it can be tracked via an optical character recognition using a camera live feed or images. Currently cameras are installed and the container no is read to identify which container moves in / out of a particular location. But all the data is managed locally and is confined to its local installation. The data is sent across to concerned users via excel format at regular intervals. Our proposal is to link all the data at once to a central or distributed system, which can be shared with concerned government departments like Customs / Excise, Port Operators, Shipping Lines and Container Operators.

A hardware/software combination solution which uses cheap hardware like Raspberry PI for IOT systems with Software that can detect Container No using a camera attached to the system. The main goal is to detect and send the container no with location of the camera in the form of string or GPS coordinates set as static as the camera is installed at a particular location and will not change frequently. Aim is to generate smaller data packets and send them across to the central repository to track the Container path. If we manage to bring the cost down or at par with the device installed on containers, using fewer devices we can track many containers now and in future if the count of containers increases.

Bringing down the cost is one of the main goals of this paper study. If shipping lines choose to install tracking devices, all the cost has to be beared by them, which is staggering, so we plan to propose an ecosystem where all the parties can benefit from it and the cost to operate the system shall be distributed among the shipping line who would like to use the system to track their containers.

The system is divided into two parts which would require a cost to operate.
1. A camera installation at a location with internet connection.
2. A central system to store all the logs of tracking.

The software can be kept free to use for all but they should be willing to agree to share the data to a central data repository. Gate / CFS / ICD / ECY Operators have to bear the cost of the hardware with camera installation locally at their premises. They will get the benefit of tracking logs for their own internal accounting purpose. Same data will also be stored in a central location for shipping lines.

The cost to maintain the Central data repository will be shared among the shipping lines.

Shipping lines respectively can upload their list of containers to make sure their container is only visible only to them.

V. OTHER POSSIBLE IMPLEMENTATIONS

Govt. is already installing many cameras on roads and intersections, the same paper with little modification of tracking Vehicle No can be used to track the vehicles moments, which will help certain govt. departments like local Police, CBI to track vehicles to track the Theft of Vehicle, and criminal activities.

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