Study on Implementation of Machine Learning Algorithm using Microprocessor at Railway Crossings

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Abstract **- The aim of the paper is to provide a better solution for control of railway crossing & prevention of accidents caused due to absence of it. In order to do that we use Microprocessor. Presently human intervention is required in order to control barriers, use of micro-processor reduces human errors & can responsibly avert drastic accidents. Making use of machine learning algorithms can pave the way for automation leading to ultimate substitution of human workforce. The workforce can then be employed more efficiently making the organization more streamlined & cost effective. It will also decrease the cost incurred by the organization as the number of employees will decrease & employees will be provided with useful tasks increasing overall efficiency.**

Index Terms **- Efficiency, Human Error, Microprocessor, Machine Learning, Railways Crossing**

INTRODUCTION

A level crossing is a point where a railway track is intercepted by road, in the absence of bridge or tunnel. In early days (still in many rural areas) a lagman was employed in the booth near the crossing whose sole job was to control the barrier. As time passed this was replaced by an electrically controlled system. These barriers had the size equal to the length of the road. Earlier the barricades were big due to the nature of traffic being livestock & manual pedestrian. As time passed, they were replaced by smaller barriers with higher visibility & relied more on the conscience of the driver of these vehicles for it to work effectively. Later [1] attempted an experiment in which 8051 Microcontrollers were used to control gates where in it relied on sensors to open or close the barrier. But it will suffer a major flaw namely the sensor malfunction. If the IR ray emitted by IR blaster was intercepted by an animal or human, then there is a very high chance that the setup might malfunction.

In order to overcome this problem, we have employed Machine Learning, a camera & a microprocessor which decides whether the object in its range is an animal, human or an actual train. This prevents unnecessary closing & opening of gates.

WORKING

We are going to use Nvidia Jetson SBC. We are going to attach a camera to this microprocessor which will be placed 1 km away from the crossing at either side. We will also take input from the signals placed near the crossing. We are using data from traffic signals as a fail-safe owing to the fact that present crop of machine learning algorithms are not 100% accurate.

1> Camera

We are going to use an 8MP camera. This will be attached to the USB post of the SBC & will be responsible for providing visual inputs to the micro-processor. These cameras employ auto-focus to adjust the visibility & prevent stray signals from entering the data. For nighttime visibility, a small light can be used to improve visibility or for further improvement a night vision system can be used.

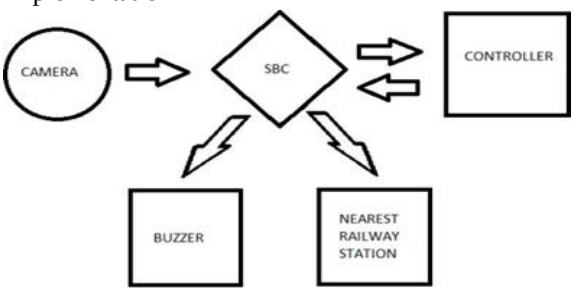
2> SBC

SBC stands for Single-Board Computer. These are miniature devices with onboard RAM, I/O ports, micro-processor & ROM [3]. Nvidia Jetson uses a quad-core ARM A57 processor clocked at 1.43ghz. It is also equipped with 128-core Maxwell GPU for faster image processing. For faster data retrieval & storage it relies upon a 4gb 64-bit LPDDR4 RAM & Flash Memory storage (M.2 SSD or MicroSD card).

3> Buzzer

A buzzer is a device that provides audio- output & is generally employed in order to alert the people in case of emergency.

Implementation



The Camera will pass on the display input to the microprocessor, the microprocessor will then run the machine learning algorithm [2], the processor will then compare the results of the machine learning algorithm with that of what is received from the signal ie. Control room. Post comparison if the processor finds out that what it inferred is not correct & is different to the signal received from the control room it will send its data to the terminal at Signal Traffic controllers room. The user at the terminal will provide the necessary input ie. If the data from the SBC is found to be correct it will allow the SBC to carry forward, if it is found to be faulty the controller will take manual control of that particular signal & make the required signal corrections. In any of the above scenarios the SBC will forward the data received from the controller to the Neural Processing Unit which is responsible for handling Machine Learning Algorithm. The Machine Learning algorithm uses Deep Learning in order to classify & differentiate one object from another [6]. The entire Image Processing works on a system of Neural networks which is made up of multiple layers [7]. Its job is to classify image inputs. The job of neural networks is handled by the NPU [8] present on the SBC. The NPU adds this data to the already present list of data to increase efficiency. The data processing capabilities of an NPU when compared with a GPU is marginally better [9]. In case the system encounters a situation where it fails (either due to unfavorable weather conditions, damage, or purposeful tampering) the SBC will send a signal to the buzzer & the alarm will go off. At the same time, an emergency signal will be sent to the Controllers terminal alerting him about the situation. A signal will also be sent to the nearest railway to get help in shortest time possible.

The algorithm that we are going to implement is Faster R-CNN [4]. This is an object detection algorithm that is derived from R-CNN. It functions by sharing full-image convolution features with detection network. It is more cost effective than R-CNN. It is written in C++ & Python.

RPN:

It stands for Region Proposal Network; it basically is a full convolutional network used to predict objectness scores at each position of object while simultaneously predicting the object bounds as well [10]. It is trained from end-to-end to generate high quality region

proposals which are required by R-CNN to detect objects.

This method has its set of drawbacks, the image detection method needs to be trained ie. It will not function out of the box. It first needs to be provided with repeated inputs while at the same time its results need to be repeatedly crosschecked with real-time observations.

The advantages of this method are that it decreases reliance on human employees [5] thus being cost effective for railways. At the same time once the SBC is trained enough it also reduces cases of human error. That said a controller needs to be appointed in order to look over the instruments ensuring that they do not malfunction.

CONCLUSION

Due to the above-mentioned factors, we observed that the accuracy of instrument run by faster R-CNN to be less during initial training period but as time passes the data logged by the instrument causes a change in accuracy. This change is positive & accuracy of the entire system increases. Also, once the system is trained enough, we can replace the lagman to other position so that the institution can compensate for the increase in manpower. As machine learning is still in its initial stage of development the accuracy is not high.

During the initial learning period the accuracy of the system is found out to be 38% as time passes & the algorithm logs data & analyses it the accuracy increases to 57%. The chances of Railway accidents dropped from 3.35% to 2.48%.

Above mentioned algorithm can also be used for face detection to help security agencies (both internal & external) to identify high profile targets.

The total saving by railways on one employee is approx. 2.8 lakh- 3.6 lakh per employee per annum. Considering Indian Railways is one of the largest employers in India as well as the world. The total govt savings will be astronomical.

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