To,

The Member Secretary,
Rajasthan State Pollution Control Board,
Jhalana Institutional Area,
Jhalana Doongri, Jaipur,
Rajasthan 302004

Dated: 30th April 2018

Sub: Regarding submitting final project plan for project execution and fund utilization.

Dear Sir,

We are glad to be selected as one of the projects to be funded under Green-a-thon 2018. It has been a great pleasure of ours to brainstorm our project with you and get your valuable feedback to iterate our proposal.

Please find attached our detailed project proposal with this letter with details of as of Rs.7.5 Lakhs and the fund utilization plan. We look forward to your acceptance of the proposal and release of first tranche of grant award.

Thanking you!

Yours truly,

Vikas Kumar Ojha

Sushant Bindra

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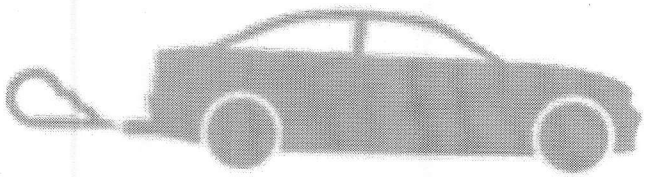
GREENATHON PROJECT

AIR BRIGADE



Under

Rajasthan State Pollution Control Board

1. Name of Project: Air Brigade

2. Details of Project team:

Team name: CarbonX

Members:

1. Vikas Kumar Ojha
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   BTech 3rd year CSE
2. Sushant Bindra
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   BTech 3rd year CSE

3. Detail of Firm (if any): Not applicable

4. Project Summary

Project Air Brigade focuses on one of the manageable forms of air pollution: vehicular pollution. The aim of this project is to develop an efficient system for monitoring vehicular pollution instantaneously. The project deals with google's Tensorflow library, which we are adapting to Indian conditions. It has components of machine learning, artificial intelligence and image processing. Our technique involves identification of different types and number of vehicles on the road at a given moment. This is done by applying machine learning algorithms on a real-time image/video obtained from a source, such as a mobile phone or a CCTV camera. After a list of vehicles is created, each vehicle is subjected to its corresponding air pollution contribution factor. The emission base value for each type of vehicle is fixed. Finally, an approximate level of air pollution at that moment is calculated. The readings can be sent to a central server for analysis.

5. Problem Statement with respect to environment

There is a lack of efficient techniques for monitoring air pollution of a particular area in real-time due to vehicles.

6. Objective

Efficient real-time monitoring of vehicular traffic and road air-pollution by application of Machine Learning.

7. Applicability area

Our goal is to implement this system at the city level. In the future, it can be expanded to State/National Level.

8. Details of any prior permission required from the government:

Yes. We required access to CCTV footage of City's traffic.

9. Registration status under startup policy, if any: Not applicable

10. Technology description

Machine Learning, Tensor Flow, Data Science, Python

11. Status of R&D

Rise in pollution has been degrading the quality of air at an alarming rate, therefore it has become essential to keep a check on the practices that cause air pollution. Here are some recent statistical facts:

1. Jaipur has about 18 lakh vehicles and adds nearly 400 vehicles a day to its existing fleet.

2. Vehicles are growing at a rate of about 10% per annum, with cars increasing at a faster rate than two-wheelers.

3. Jaipur has 551 vehicles per 1,000 people compared to Delhi at 332 vehicles.

4. The level of traffic congestion in Jaipur is that 60 percent of the cities' roads are used for parking – the highest in any city in India.

At a national level, the total vehicle population in 1951 was 0.3 million. It comprised of 8.8% two wheelers, 52% cars, jeeps and taxis, 11.1% buses, 26.8% goods vehicle and 1.3% other vehicles. The total vehicle population in 2001 was 55 million. It comprised of 70.1% two wheelers, 12.8% cars, jeeps and taxis, 1.2% buses, 5.4% goods vehicle and 10.5% other vehicles. As compared to the year 1981, the share of two wheelers changed by 21.5%, the share of cars, jeeps and taxis changed by -8.7%, the share of buses changed by -

1.8%, the share of goods vehicle changed by -4.9% and the share of other vehicles changed by -6.1%.

As on 31st March	2W	4W	Buses	Goods vehicles	Other vehicles	Total (in millions)
	As % of total vehicle population					
2004	71.4	13	1.1	5.2	9.4	72.7
2005	72.1	12.7	1.1	4.9	9.1	81.5
2006	72.2	12.9	1.1	4.9	8.8	89.6
2007	71.5	13.1	1.4	5.3	8.7	96.7
2008	71.5	13.2	1.4	5.3	8.6	105.3
2009	71.7	13.3	1.3	5.3	8.4	115.0
2010	71.7	13.5	1.2	5.0	8.6	127.7
2011	71.8	13.6	1.1	5.0	8.5	141.8

Figure: Composition of vehicles population of India

The total vehicle population in 2015 was 210 million. It comprised of 73.5% two wheelers, 13.6% cars, jeeps and taxis, 1% buses, 4.4% goods vehicle and 7.5% other vehicles. As compared to the year 2001, the share of two wheelers changed by 3.40%, the share of cars, jeeps and taxis changed by 0.80%, the share of buses changed by -0.2%, the share of goods vehicle changed by -1% and the share of other vehicles changed by -3%. Therefore, it can be inferred by the foregoing data analysis, that the composition of vehicle population in India has shown significant variation during the period under consideration i.e. 1951 to 2015. The share of two wheelers has consistently increased; while the share of buses and goods vehicle has consistently decreased. The share of cars, jeeps and taxis decreased in earlier period; but has increased during the period from 2001 to 2015.

12. Technology acceptance at international/national level: Accepted

13. Work plan

13.1 Methodology

About TensorFlow

TensorFlow™ is an open source software library for numerical computation using data flow graphs. Nodes in the graph represent mathematical operations, while the graph edges represent the multidimensional data arrays (tensors) communicated between them. The

flexible architecture allows you to deploy computation to one or more CPUs or GPUs in a desktop, server, or mobile device with a single API. TensorFlow was originally developed by researchers and engineers working on the Google Brain Team within Google's Machine Intelligence research organization for the purposes of conducting machine learning and deep neural networks research, but the system is general enough to be applicable to a variety of other domains as well.

13.2 Working

1. Initially, we upload an image to our system. The quality of the image should be good, so that detection can take place with maximum accuracy.

2. Then, we apply Machine Learning algorithms to analyze the uploaded image. The system recognizes different types of vehicle in the image. We are using Google's TensorFlow API for object detection.

3. The system filters out differentiated vehicles from all the objects recognized in images.

4. The algorithm works by grouping vehicles according to predefined types, such as a car, bus, truck or motorcycle.

5. To estimate the road-air pollution, we are considering Emission Factor (g/km) as base value for each type of vehicle.

6. The final step is to approximate the level of different pollutants such as CO, HC, NOx, Co2 and PM from the image. This is done by considering the number of vehicles of each type and subjecting them to their respective base value.

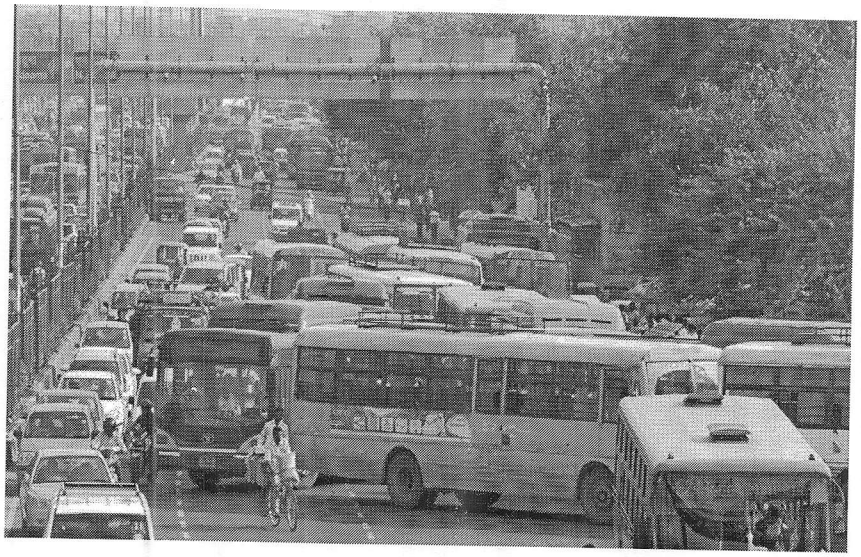

Figure: Original Image

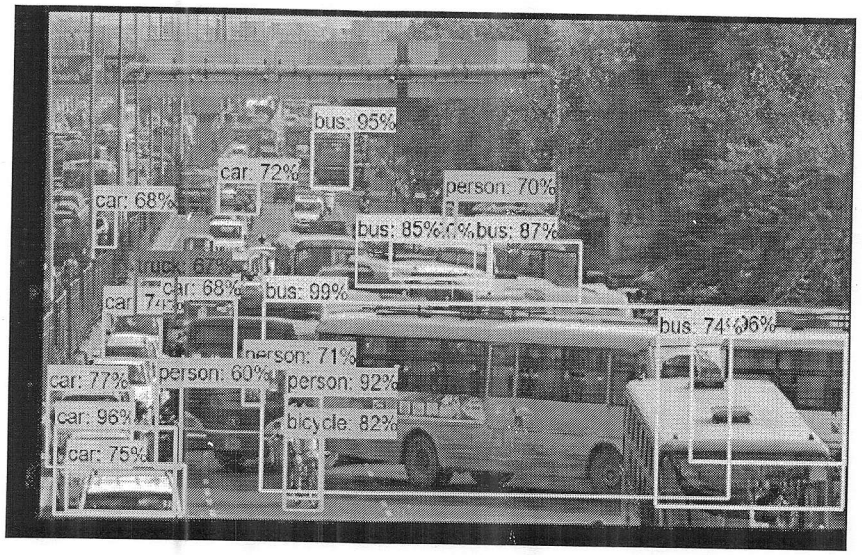

Figure: Image after analysis by the system

13.3 Stages of Project

We will be completing our proposed project in 3 well defined stages:

Stage 1: Model training for detection of vehicles

Duration: 50 days

Description: After receiving the work order and one week traffic footage of one specific location in the city by RSPCB, we will start developing a training model which will detect different types of vehicles by implementing machine learning algorithms. We will filter the results using image processing. Since the training of models will require high-processing power, we will need a high-end laptop along with separate Graphical Processing Units (GPUs). We will also require camera equipment to shoot high-definition media (images and videos) which will serve as input to our software system.

Outcome: A program for detection of the vehicles.

Proposed release of funds: **₹ 4,50,000**

Stage 2: Validation of model and generation of Heat maps

Timeline: 30 days

Description: After completing stage 1, we will validate our trained model in real time to check the accuracy of the detection. The model can then be improved if required. After validation we will analyze the data generated by our model to predict the trends for vehicles which can help to monitor pollution level. We will work on creating heat maps of different time frames within day (Morning, Afternoon, Evening and Late night) and generate trend analysis of vehicles for the use of RSPCB.

Proposed release of funds: **₹ 1,50,000**

Stage 3: Final testing and delivery of the program

Timeline: 25 days

Description: After completion of Stage 2, we will perform final testing using the actual footage from traffic camera provided by RSPCB and deliver the program.

Proposed release of funds: **₹ 1,50,000**

14. Details of place where work to be performed:

We will be working on this project in Jaipur. We're planning to stay in the city on rent flat. We will be traveling often in the city for field testing and capturing videos and images for training and testing our software.

15. Detailed Budgetary Estimation:

Enclosure-1

16. Project Funding:

The project funding will be provided by the Rajasthan State Pollution Control Board.

17. Expected outcomes:

1. Creation of robust data on levels of road vehicles, road air-pollution level at different instants along with affected areas & peaking trends.
2. Generating heat-maps of city at various time of the day for use of RSPCB.
3. Determining the congestion in a particular area at a specific time form the data.
4. Evaluating changes in air quality as a result of state implementation plans.

18. Viability of project in terms of expenses and benefits:

By providing real time dashboards for the concerned authorities, analyzing the type and number of vehicles will help them in policy making for controlling vehicular pollution. (Example - Policies like Odd Even rule would be more efficient with data provided by dashboards.)

Heat maps of the data can help them in locating and comparing areas in terms of vehicular pollution.

19. Benefits from the projects (Estimated, financial etc.):

Prospects of the project can be seen with time.

20. Details of support required from RSPCB:

1. Mentorship and guidance throughout the project.
2. Access to traffic CCTV footage as mentioned in stage 1 for testing and analysis.
3. Integration of software to the cameras that are already installed in the city for field testing.

21. Proposed release of funds expected from the RSPCB:

We request the RSPCB to release the proposed funds as soon as possible for Stage 1, so that we can purchase the necessary equipment and begin working on our project.

22. Details of recognition/patent of technology: Applicable

23. Technical support for implementation of the projects

Technical support is preferred

Enclosed:-

1. Project Budgeting

Budget Estimation

S No.	Budget Head	Total Budget
1	**Personal Cost**	
1.1	Rent	₹45,000.00
1.2	Internet	₹15,000.00
1.3	Travel	₹50,000.00
1.4	Living Expenses	₹50,000.00
2	**Capital Expenditure**	
2.1	Computer Peripherals	₹300,000.00
2.2	Camera Equipment	₹60,000.00
2.3	Technical Accessories	₹60,000.00
3	**Adminstration & Technical Cost**	
3.1	Tech Support	₹80,000.00
3.2	IT Repairs	₹20,000.00
3.3	Stationery	₹20,000.00
3.4	Miscellaneous	₹50,000.00
	Total	₹750,000.00

Stages	Funding
Stage 1	₹450,000.00
Stage 2	₹150,000.00
Stage 3	₹150,000.00
Total	₹750,000.00