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Smart Control of Traffic Light

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Abstract— *In today's generation as we see the population of our country is increasing day-by-day and due to this lots of vehicles crowd has been arised and due to this we have to face many problems, one of this is traffic congestion in cities and it's becoming more serious issue day after day for controlling traffic as the vehicles increasing on road. So for this, conventional traffic system which is done at the signals does not have proper monitoring system and often requires manual handing at traffic signals. This not only causes people mental stress on driving but also lot of fuel goes wasted due to delay at traffic signals. This requires some new modification module of a system to handle traffic signals in a smart way by automatically adjusting its timing based on traffic density using Arduino Uno ATMega 328. In this, traffic is detected using digital IR Sensors which detects the flow of traffic at particular lane and IR Sensors detect vehicles further based on the signal reflected from them. Sensors are placed at the adjacent to road side to control the traffic density by changing traffic signal appropriately using the lane traffic. The IR Sensors which are interfaced with Arduino Uno which reads data from IR Sensors. The Traffic Signal which we see is designed using LEDs light and each signal consist two LEDs for each lane. Using this concept system development at traffic junction we need not to take tension about handing the traffic manually and also consumes less time as compared to the conventional traffic system which are working today. We harness solar power from solar panel and this is used to build prototype working model of smart traffic signal which automatically adjusts its timing based on traffic direction.*

Keywords: *Traffic Light System, Infrared Sensors, Arduino Uno ATMega 328 Microcontroller, Light Emitting Diodes*

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I. INTRODUCTION

In our todays day to day life as we face many problems regarding of traffic jam and which is becoming more serious issue due to increased of population continuously due to raise in number of vehicles. The underdeveloped infrastructure and inadequate distribution of development are inflicting various problems. Smart traffic light signals are required to cut back the traffic delay and travel times more importantly in developing cities. As current traffic systems are handled manually or using fixed timing signal systems. So we need smart and fast smooth traffic handling systems. The traffic lane on a signal which has additional number of vehicles and the traffic light is made green and red light for the other remaining side until traffic on that lane is cleared as basically we see in the metro cities which would help in smooth movement of traffic and also increase comfort and driving safety of the travellers. The system uses counter mechanism to find the number of vehicles on each lane which leads to processing overhead. So in our proposed system the total of vehicles on each lane is estimated and state (ON/OFF) of LEDs light change accordingly hence program flow is simpler and processing overhead is reduced.

The smart traffic control system is meant to manage the traffic signals based on the traffic density of the lane. It's designed to sense traffic, manage the traffic based on density by operating the traffic signals appropriately. The traffic is detected using IR sensors. The IR sensors detect vehicles based on the light reflected from them. They are placed adjacent to the road and facing the lane, so that they can detect the traffic. Also, we will place them at a significant distance from the junction such that they detect jam traffic only after a threshold is reached. Basic block diagram is shown in Fig.1.The Adriano Uno which acts as the brain of the system will read data continuously from the IR sensors. Complete flowchart of various steps involved is shown in Fig.2. It will determine the traffic density depending on the information received from the sensors, based on the traffic density of every lane it will control the traffic signals which will then use the stagnation of traffic. The traffic signals for the system are designed using LEDs. each signal has two LEDs, one red and one green. We will design a traffic control system for a four lane junction. There will four digital IR sensors, one for each lane and there will 8 LEDs which act as the traffic signals for each of the lanes. Each digital IR sensor has four terminals,

the digital outpins of the sensors ar connected to the digital pins 8-11 of the arduino uno. These will be used to read data from the IR sensors. The analog pins are left unconnected. Whereas the Vcc and ground pins are connected to the power supply. The cathode pins of all the LEDs are connected to the common ground of the traffic control system. The anodes of the LEDs are used to send the signal and switch them ON/OFF. The anodes of all the LEDs are connected to digital pins 0-7 of the Arduino Uno which is essentially the port D of the board. The projected smart density based traffic light system resolves this problem by utilizing IR sensors. The proposed smart density based traffic light system handles the issues in very efficient way. The rest of the paper is arranged in following manner – section 2 describes the problems in the conventional traffic handling systems. Section three describes the proposed design and methodology, section four provides the results and sectionfive concludes the paper.

II. LITERATURE REVIEW

In the last few years, a large number of researches have been done to reduce problems regarding these jams. For example, a traffic light with microcontroller, ultrasonic sensor, automatic switch, manual controller switch, circuit anddisplayer which were functioning to handle all the system process, figure out jammed level in traffic, switch between manual and auto mode, control traffic light manually, make sure process happened and display the wanted output, respectively was created [5]. In 2014, a traffic light controlling system using microcontroller and light emitting diode (LED) was introduced by Ganiyu R. The microcontroller job is to receive a logic one instruction indicating that a switch, in this case a pressure switch sensed a weight of a car which passed on it. Each time microcontroller received logic one, time will be added to another 15 seconds and eventually trigger LED to light on at 15 seconds delay in that particular lane or traffic light.

Jianhua Guo et al [7] introduced a new method for area-wide traffic signal timing optimization under user equilibrium traffic. The optimization model was formulated as a multi-dimensional search problem aimed to achieve minimized product of the total travel time associated with urban street network and the variance of travel time for unit distance of travel. A genetic algorithm was developed to derive the model solution. A simulation control protocol embedded in PARAMICS software tool capable of conducting area-wide micro simulation is adopted to design the logic frame and function module of the area-wide traffic signal control system. His results shown that mobility improvements are achieved after applying the proposed model along with the genetic algorithm for area-wide signal timing optimization, assessed by extended capacity ratio, and reductions in through and turning movement delays, as well as average and variance of travel time for unit distance of travel.

Gustav Nilsson _ Giacomo Como [4] focused on a class of dynamic feedback traffic signal control policies that are based on a generalized proportional allocation rule. There results in a differential inclusion for which there prove existence and, in the special case of orthogonal phases, uniqueness of continuous solutions via a generalization of the reflection principle. Stability is then proved by interpreting the generalized proportional allocation controllers as minimizes of a certain entropy-like function that is then used as a Lyapunov function for the closed-loop system.The Real- time Driver Drowsiness Detection for Android Application Using Deep Neural Networks Techniques, 2018, Procedia Computer Science, Elsevier In this publication, an advanced approach is devised for real-time drowsiness detection. It is based on deploying a deep neural network toan Android application which achieves high accuracy. The most significant achievement of this work is the usage of lightweight model which is obtained from a heavy baseline model. The model achieves an accuracy of more than 80%.[3] Junchen Jin and Xiaoliang Ma [8] proposed a group-

based signal control approach capable of making decisions based on its understanding of traffic conditions at the intersection level. The control problem is formulated using a framework of stochastic optimal control for multi-agent system in which each signal group is modeled as an intelligent agent. The proposed system is designated to be compatible with the prevailing signal system. The parameters were off-line optimized using a genetic algorithm. Simulation results shown that the proposed adaptive group based control system outperforms the optimized GBVA control system mainly because of that's real-time adaptive learning capacity in response to the changes in traffic demand.

Nasser R. Sabar et al [11] controlled the movement of traffic on urban streets by determined the appropriate signal timing settings. Proposed algorithm was based on the

So-called memetic algorithm that combines the strengths of the genetic algorithm and local search in an adaptivemanner. In that used two important techniques for improvingthe performance of traditional memetic algorithms. First, a systematic neighborhood basedsimple descent algorithm was employed as a local search to effectively exploit the search space. Second, an indicator scheme was proposed to control the local search application based on the quality and diversityof the search process. The proposed algorithm was coded in the commercial microscopic traffic simulator, AIMSUN, and tested on two difference real world case studies in Brisbane, Australia, and Plock, Poland. The results demonstrated that the proposed algorithm was better than genetic algorithms and fixed-time settings, indicated that the proposed algorithm was an effective solution

method for traffic signal optimizationproblems.

Mohammad Aslani et al [9] utilized RL (Reinforcement learning) algorithms to design adaptive traffic signal controllers called actor-critic adaptive traffic signal controllers (A-CATs controllers). Worked done rested on the integration of three threads: (a) shows performance compared of both discrete and continuous A-CATs controllers in a trafficnetwork with recurred congestion (24- h traffic demand) in theupper downtown core of Tehran city,

(b) analysed the effects of different traffic disruptions included opportunistic pedestrians crossing, parking lane, non- recurring congestion, and different levels of sensor noise on the performance of A-CATS controllers, and (c) compared the performance of different function approximators (tile coding and radial basis function) on the learning of A-CATs controllers. First an agent based traffic simulation of the study area was carried out. Then six different scenarios are conducted to find the best A-CATs controller that was robust enough against different traffic disruptions. They observed that the A-CATs controller based on radial basis function networks(RBF (5)) outperforms others. They said that RBF
(5) was benchmarked against controllers of discrete state Qlearning, Bayesian Q-learning, fixed time and actuated controllers; and the results revealed that (RBF (5)) consistentlyoutperforms others.

Huajun Chai et al [5] captured the interaction betweentravellers' route choice and traffic signal control in a coherent framework. They tested their algorithm and control strategy bysimulation in OmNet++ (A network communication simulator)and SUMO (Simulation of Urban Mobility) under several scenarios. The simulation results shown that with the proposeddynamic routing, the overall travel cost significantly decreases.It was also shown that the proposed adaptive signal control reduced the average delay effectively, as well as reduced the fluctuation of the average speed within the whole network.

Ekinhan Eriskin et al [3] suggested a new method for designing traffic signal timing at oversaturated intersections was expressed "the elimination pairing system". An object function with vehicle delay and stop-start numbers has been generated. Total cost value has been calculated according to the object function. Obtained results were compared with Webster as a traditional traffic signal timing design method and Transyt 14 signal timing software. While Webster gives exaggerated results, Transyt 14 and Elimination Pairing Systems provided better results. As a result of that study, the elimination pairing system could be used for optimizing the traffic signal timings. The author Shailendra Tahilyani et.at. [16] developed a new lane bypass algorithm for route diversion given a result in smooth traffic flow on the urban road network. Genetic algorithms are utilizedfor the parameter optimization. Ishant Sharma and Dr. Pardeep

K. Gupta [6] proposed to replace existed traffic signals with a system that are monitored the traffic flow automatically in traffic signaland sensors are fixed in which so the time feed are made dynamic and automatic by processed the live detection.

Chandrasekhar.M et.al. [2] suggested a system thatimplement image processing algorithm in real time traffic light control which will control the traffic light efficiently. Ramteke Mahesh K. et.al. [12] proposed FPGA (Field Programmable Gate Array) controller based on Neuro-Fuzzy system thought provided effective solution for Traffic Control. It can used to minimize drawbacks of the conventional traffic controllers with the accuracy of provided variation in green cycle intervals basedon the heavy traffic loads that changed at every lane in a four leg intersection. Naren Athmaraman and Srivathsan Soundararajan [10] introduced an adaptive predictive signal control system that performed real time queue length estimation and employed an efficient signal coordination algorithm with APTTCA- based system. Pavan Kumar and Dr. M. Kamala kumara [17] studied adaptive traffic control systems with VANET, Focused on reliable traffic prediction approaches and various types of adaptive traffic control algorithms also proposed a mobile crowd sensing technology to support dynamic route choices for drivers to avoid congestion. Suggested crowd sourcing can be one of the best options for Adaptive traffic control system for India. Prof. Jayesh Juremalani and Dr. Krupesh A. Chauhan [18] author describedvarious soft computing techniques to tackle traffic controlsystem. Which are fuzzy approaches, neural network and genetic algorithms, ant colony algorithm, particle swarm optimization, simulation model.

III. PROBLEM STATEMENT

Many of the times people have to wait for a long time at traffic signals which occurs stress to the drivers which has no specific pattern that is followed, and the static signal timers pose a huge problem. This project is to develop a smart control of traffic light which aims to reduce chances of such scenarios by automatically detecting the lane traffic through IR Sensors which is fitted at the road side and after detecting the vehiclethe optimal green signal time based on the current traffic at the signal will ensure that the direction with more traffic is allotted a green signal for longer duration of time as compared to the direction with lesser traffic. This system can override the older system which cause unwanted delays, reducing congestion, accidents and fuel consumption which will help in controlling the air pollution.

OBJECTIVESThe objectives are as follows:

1) This project is design to control traffic light based on the flow of traffic that can adapt to the current traffic situation.
2) In this, IR Sensors detect vehicles further based on the signal reflected from them.
3) Afterwards they are interfaced with Arduino Uno andit reads data from IR Sensor
4) Our proposed system aims to use IR Sensors at traffic signals for real-time traffic density calculation by detecting the vehicles at the signal and set the green time accordingly.

IV. METHODOLOGY

A. *A central control system:-*

The central control system acts as a base of a traffic control system. This system is integrated with traffic lights, signals, IR Sensors detectors. The Arduino Uno helps in passing IR Sensors message on an optimized information to control the functioning of the traffic lights and signals for thefree flow of traffic.

B. *Smart signal lights:*

Smart traffic lights and signals reduce the inefficiencies intraffic congestion and idle time at intersections. The intelligent lights can manage the lane and clear the traffic irrespective of the predefined timing system.

C.

The IR Sensors updates information to the control systemabout the real-time traffic condition and the control system enacts this real-time information to clear the overcrowding traffic and helps in reducing air pollution.

V. APPROACH

1) Approaches used to make traffic routing and light signal allocation decisions. For instance adaptive (learning)versus non-adaptive strategies; offline versus real time strategies; and hybrid strategies.
2) Number and types of parameters/variables (input and output) used. We review systems that use single variables(e.g. traffic quantity) and ones that use several variables (e.g. traffic quantity, past and present traffic data knowledge) to make traffic routing decisions.
3) Traffic data collection methods used (such as sensor types) and communication methods applied (such asmulti-hop or single-hop) to transmit collected data.
4) STCS that control traffic at an isolated junction or multiple intersection junction or both

VI. PROPOSED SYSTEM

The traffic is sensed using digital IR sensors. The IR sensorsdetect vehicles based on the light reflected from them. They areplaced adjacent to the road and facing the lane, so that they can detect the traffic. Also, we will place them at a significant distance from the junction such that they detect traffic only after a threshold is reached. Basic block diagram shown in figure below. The Arduino Uno which acts as the brain of the system will read data continuously from the IR sensors. Complete flowchart of various steps involved is shown in figure below. It will determine the traffic density depending on the information received from the sensors, based on the traffic density of every lane it will control the traffic signals which will then use the stagnation of traffic. The traffic signals for the system are designed using LEDs. Each signal has two LEDs, one red and one green. We will design a traffic control system for a four lanejunction. There will four digital IR sensors, one for each lane andthere will 8 LEDs which act as the traffic signals for each of thelanes.

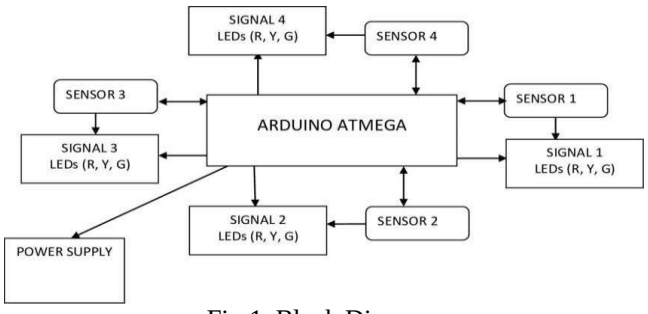


Fig.1: Block Diagram

A. System Architecture:

The designed smart traffic light control system corresponds to a junction of 4 mono directional roads in the form of "+" as shown in Fig. 1. We aim in the first place to investigate the techn *Intelligent systems:* isting systems and seek the most appropriate employed devices. We try also to test the proposed integrated design as architecture, hardware, and software. Next step will be an extension of the suggested

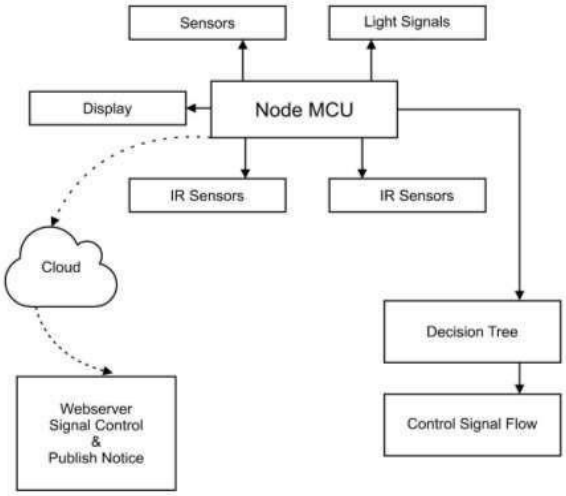


Fig.2: System Architecture

traffic light system to a bidirectional "+" junctionwith various routing configurations. Our research target involves themanagement of traffic light systems for multiple adjacent bidirectional roads.

VII. MODULE

Our system uses an algorithm to analyze flow of traffic. Our developed system consists of 3 modules, which are Proposed System, Vehicle Detection & Signal Switching

1) Proposed Module: Our proposed system will detect vehicles using IR Sensors at traffic signals for real-timetraffic density calculation for easy flow of traffic. We areusing IR Sensors for object detection in order to detect vehicles or any other obstacles. The scheduling algorithm will uses this traffic density and appropriately set the optimal green signal time for each signal, and updates the red signal times of the other signals by the lane traffic.

2) Vehicle Detection Module: The IR sensors detect vehicles based on the vehicles crowd from particular lane. It is placed adjacent to the road so that it can detectproperly the traffic status. Also, we will place them at a significant distance from the junction such that they detect stagnant traffic only after a particular count is reached. Basic block diagram is shown in Fig.1.The Arduino Uno which acts as like the brain of the system will read data continuously from the IR sensors.

3) Signal Switching Module : The working process of traffic signals for the system is designed using LEDs light. Each signal has two LEDs, one is red and another one is green. As we had design a traffic controlsystem for a four lane junction in which four digital IRsensors are present, one for each lane and there will 8 LEDs which act as the traffic signals for each of the lanes. Each digital IR sensor has four terminals, the digital out pins of the sensors ar connected to the digital pins 8-11 of the arduino Uno. And afterwards it reads data from the IR sensors. It sets the green signal timer according to traffic density returned by vehicle detection module. It updates the red signal according to others lane.

ALGORITHM'S

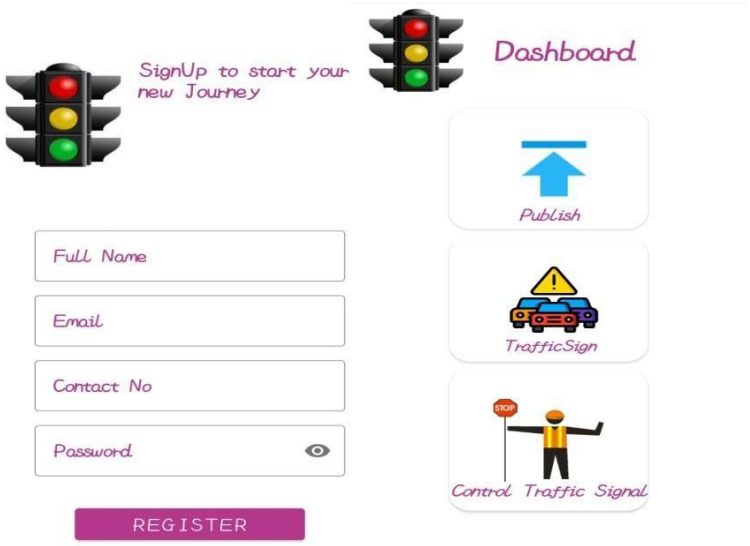
A. Vehicle Counter Algorithm:-

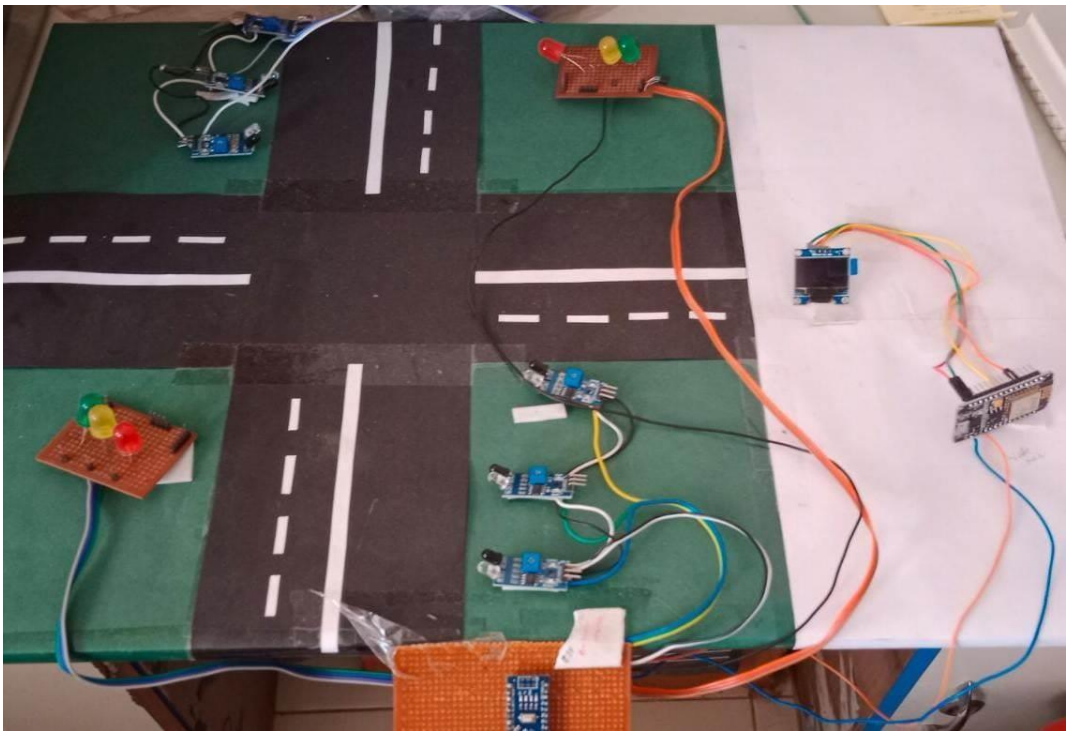
Assuming the objects detected by the IR Sensors to bevehicles, int counter = 0;
int hitObject = false; int val ;
Step 1: Read value from sensor (val). Sensor gives output 0if car is detected and 1 if no car is detected.
Step 2: If val == 0 hitObject = false then increment the counter and set hitObject = true. else if val == 1 hitObject = true
then set hitObject =false. Step 3: Go to step 1.

B. Traffic Control Algorithm:-

No. of sensors = 8 and are denoted by S1, S2, S3, S4, S5, S6,S7, S8
No. of cars in Lane 1 (N1) = S1 – S2 No. of cars in Lane 2 (N2) = S3 – S4No. of cars in Lane 3 (N3) = S5 – S6
No. of cars in Lane 4 (N4) = S7 – S8
Li = (L1, L2, L3, L4), Ni = (N1, N2, N3, N4), Ti = (T1, T2,T3, T4)
Step 1: Start
Step 2: Sensors will read the no. of vehicles on each lane (i.e.
L1, L2, L3, L4)

Step 3: if (Vehicle Count < Threshold)
Then status = Normal traffic. Turn on the green signal for allthe lanes one after another in a sequential manner (L1-L2-L3- L4). When signal is green for one lane,the others will remain red.
Step 4: else status = congestion.
Step 5: COMPARE (N1, N2 , N3, N4), Select the highest ofthe four (say Ni),turn on green signal for that lane (say Li) for time (Ti). When time Ti ends, turn on the red signal.
Step 6: COMPARE (N2, N3, N4), Select the highest of the three (say Ni), turn on green signal for that lane (say Li) for time (Ti). When time Ti ends, turn on the red signal.
Step 7: COMPARE (N3, N4), Select the highest of the two (say Ni), turn on green signal for that lane (say Li) for time (Ti).When time Ti ends, turn on the red signal.
Step 8: The last remaining lane automatically gets selected and it is given the green signal for time Ti.
Step 9: Jump to Step 3.





VIII.CONCLUSION

So we have successfully designed smart control trafficlight system which handles traffic in an efficient way to reduce congestion using IR sensors which detects the vehicles strength at lane and Arduino Uno read data continuously from the IR sensors by minimizing the delay.By implementing this system we've got to reduce the possibilities of traffic jams to an extent and we havesuccessfully got the result. Thus, the proposed system setsthe green signal time adaptively according to the traffic density at the signal and ensured that the direction with more traffic is allotted a green signal for longer duration oftime as compared to the direction with lesser traffic and itwill lower the unwanted delays at signal, reduce the fuel consumption of vehicles and also the air pollution.

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