Traffic Relief

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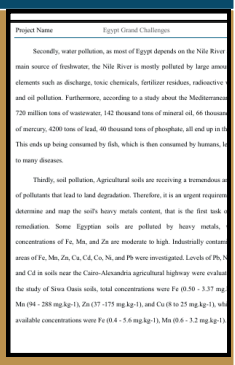
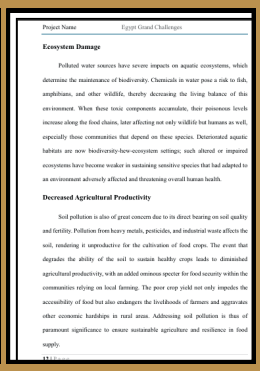
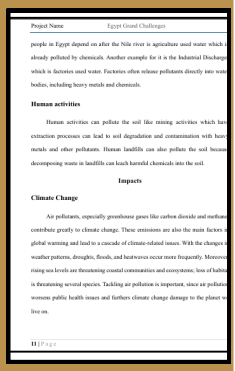
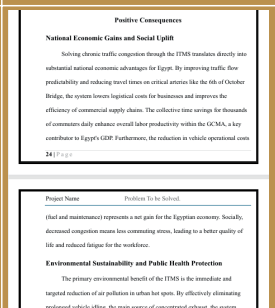
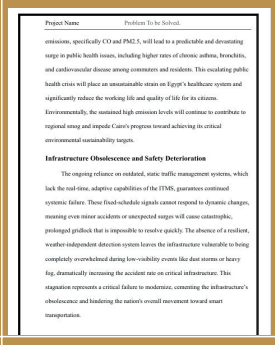
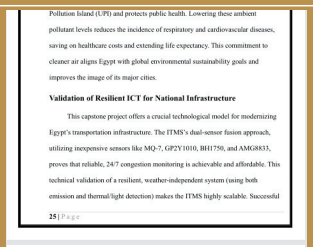
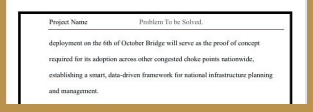
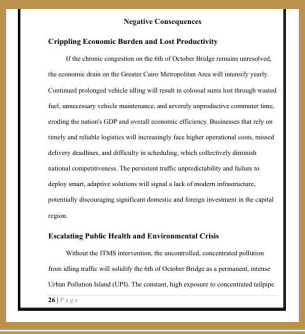
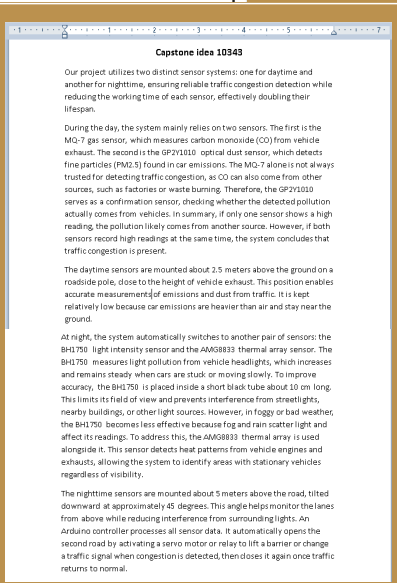
STEM High School

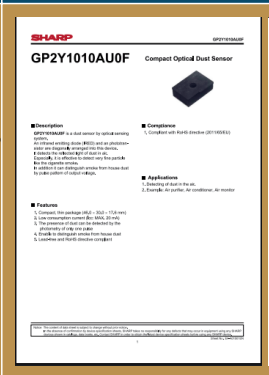
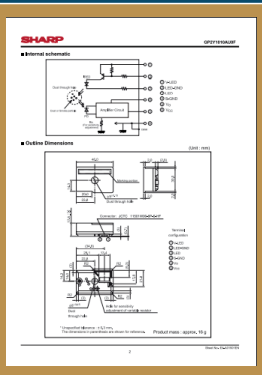
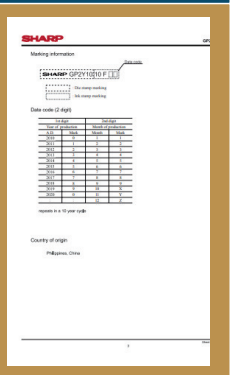
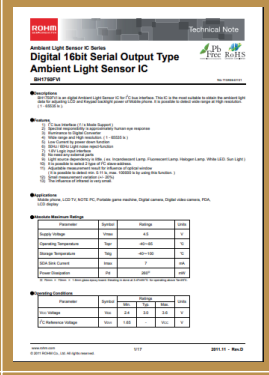
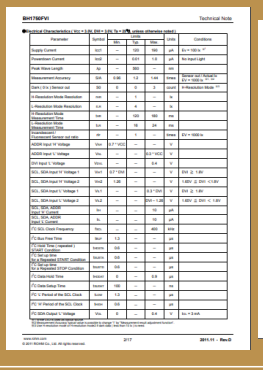
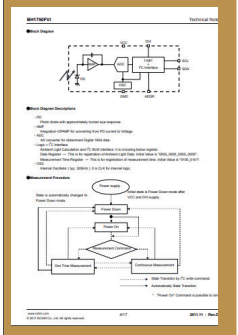
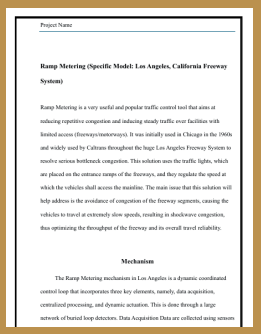
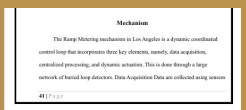
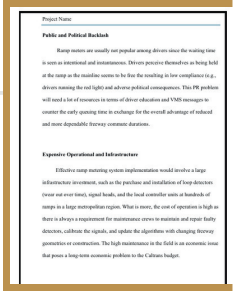
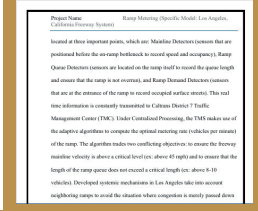
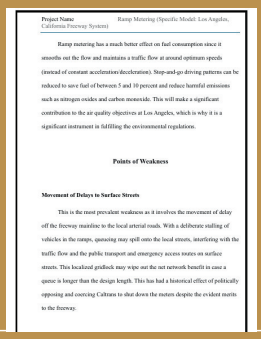
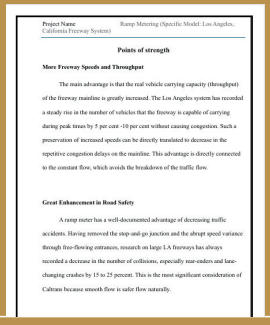
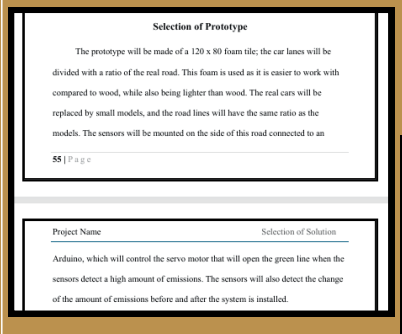
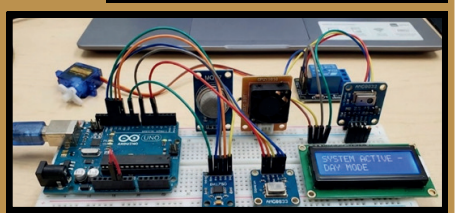
for boys – 6th of October

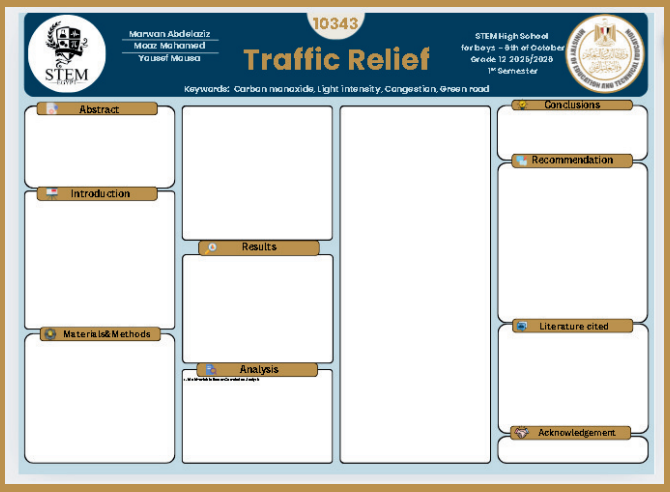
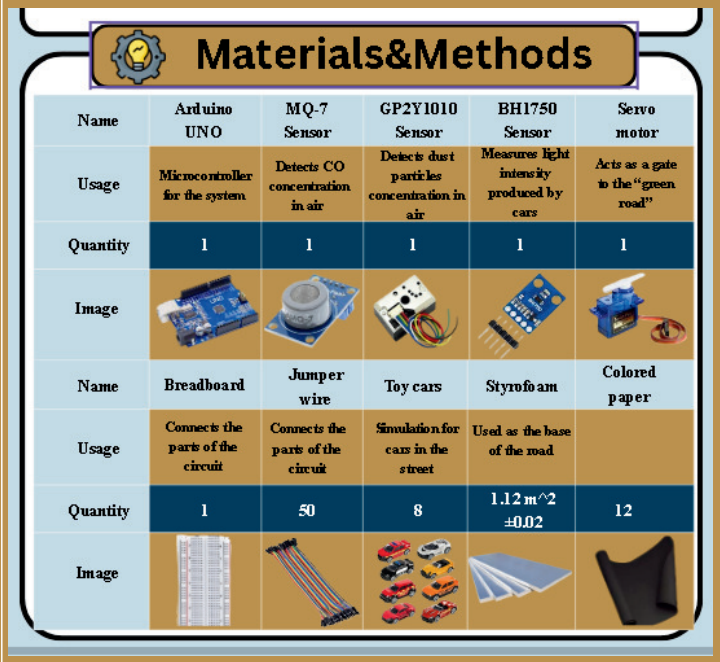
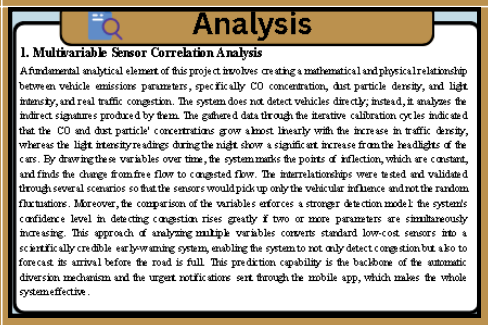
Grade 12 2025/2026

1st Semester

10343

Weeks	Tasks	Proof
Week One	Addressing the capstone project challenge and writing introduction of chapter 1 and grand challlenge “ Address and reduce pollution fouling our air, water and soil”	     
Week Two	Writing the positive consequences and negative consequences for the project,	    
Week Three	Searching for our unique solution and suitable sensor type for it, and writing the full idea document to submit for the school capstone leader	

Weeks	Tasks	Proof
Week Four	Reviewing the datasheet for sensors to ensure their suitability for the project	     
Week Five	Searching for privious solutions for the same challenge and the prior solution was written as shown	     
Week Six	Buying materials (all sensors and the foam to simulate the road), and writing selection of prototype	  

Weeks	Tasks	Proof
Week Seven	Making the design for the poster	
Week Eight	Making the table of materials in the poster	
Week Nine	Writing the first point of analysis in the poster and constructing the prototype	 

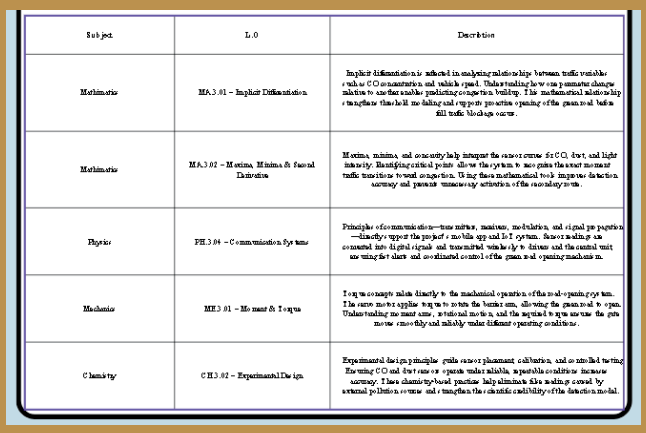
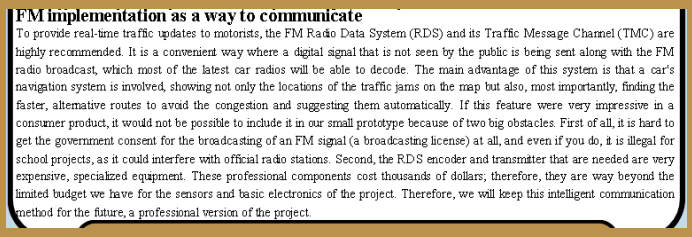
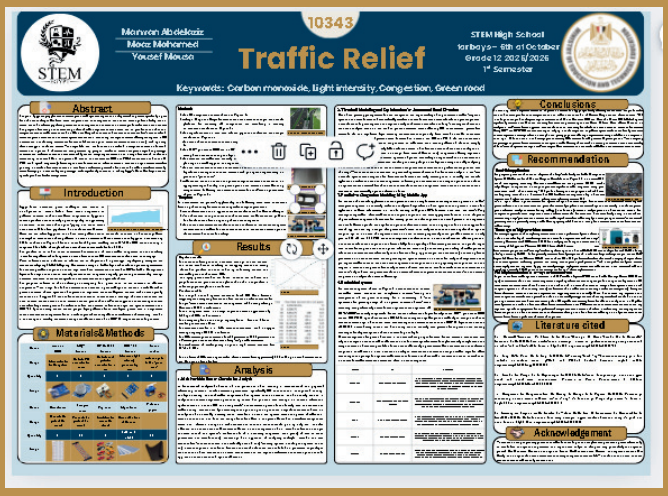
Materials&Methods

Name	Arduino UNO	MQ-7 Sensor	GP2Y1010 Sensor	BH1750 Sensor	Servo motor
Usage	Microcontroller for the system	Detects CO concentration in air	Detects dust particles concentration in air	Measures light intensity produced by cars	Acts as a gate to the "green road"
Quantity	1	1	1	1	1
Image					
Name	Breadboard	Jumper wire	Toy cars	Styrofoam	Colored paper
Usage	Connects the parts of the circuit	Connects the parts of the circuit	Simulation for cars in the street	Used as the base of the road	
Quantity	1	50	8	1.12 m^2 ±0.02	12
Image					

Analysis

1. Multivariable Sensor Correlation Analysis

A fundamental analytical element of this project involves creating a mathematical and physical relationship between vehicle emissions parameters, specifically CO concentration, dust particle density, and light intensity, and real traffic congestion. The system does not detect vehicles directly; instead, it analyzes the indirect signatures produced by them. The gathered data through the iterative calibration cycles indicated that the CO and dust particle' concentrations grow almost linearly with the increase in traffic density, whereas the light intensity readings during the night show a significant increase from the headlights of the cars. By drawing these variables over time, the system marks the points of inflection, which are constant, and finds the change from free flow to congested flow. The interrelationships were tested and validated through several scenarios so that the sensors would pick up only the vehicular influence and not the random fluctuations. Moreover, the comparison of the variables enforces a stronger detection model: the system's confidence level in detecting congestion rises greatly if two or more parameters are simultaneously increasing. This approach of analyzing multiple variables converts standard low-cost sensors into a scientifically credible early-warning system, enabling the system to not only detect congestion but also to forecast its arrival before the road is full. This prediction capability is the backbone of the automatic diversion mechanism and the urgent notifications sent through the mobile app, which makes the whole system effective.

Weeks	Tasks	Proof
Week Ten	Making the tabel of LOs in the poster	
Week Eleven	Writing the last point of recommendations in the poster	
Week Twelve	All parts were collected in the full size poster and it was submitted to the capstone leader	

Subject	L.O	Description
Mathematics	MA.3.01 – Implicit Differentiation	Implicit differentiation is applied in analyzing relationships between traffic variables such as CO concentration and vehicle speed. Understanding how one parameter changes relative to another enables predicting congestion buildup. This mathematical relationship strengthens the ability of modeling and supports proactive opening of the geared roof before full traffic blockage occurs.
Mathematics	MA.3.02 – Maxima, Minima & Second Derivative	Maxima, minima, and concavity help interpret the sensor curves for CO, dust, and light intensity. Identifying critical points allows the system to recognize the exact moment traffic transitions toward congestion. Using these mathematical tools improves detection accuracy and prevents unnecessary activation of the canopy system.
Physics	PH.3.04 – Communication Systems	Principles of communication—transmitters, receivers, modulation, and signal perception—directly support the project's mobile app and IoT system. Sensor readings are converted into digital signals and transmitted wirelessly to drivers and the central unit, ensuring fast alerts and coordinated control of the geared roof opening mechanism.
Mechanics	ME.3.01 – Moment & Torque	Torque concepts relate directly to the mechanical operation of the roof-opening system. The servo motor applies torque to rotate the barrier arm, allowing the geared roof to open. Understanding moment arms, rotational motion, and the applied force ensures the gate moves smoothly and reliably under different operating conditions.
Chemistry	CH.3.02 – Experimental Design	Experimental design principles guide sensor placement, calibration, and controlled testing. Ensuring CO and dust sensors operate under reliable, repeatable conditions increases accuracy. These chemistry-based practices help eliminate false readings caused by external pollution sources and strengthen the scientific credibility of the detection model.

FM implementation as a way to communicate

To provide real-time traffic updates to motorists, the FM Radio Data System (RDS) and its Traffic Message Channel (TMC) are highly recommended. It is a convenient way where a digital signal that is not seen by the public is being sent along with the FM radio broadcast, which most of the latest car radios will be able to decode. The main advantage of this system is that a car's navigation system is involved, showing not only the locations of the traffic jams on the map but also, most importantly, finding the faster, alternative routes to avoid the congestion and suggesting them automatically. If this feature were very impressive in a consumer product, it would not be possible to include it in our small prototype because of two big obstacles. First of all, it is hard to get the government consent for the broadcasting of an FM signal (a broadcasting license) at all, and even if you do, it is illegal for school projects, as it could interfere with official radio stations. Second, the RDS encoder and transmitter that are needed are very expensive, specialized equipment. These professional components cost thousands of dollars; therefore, they are way beyond the limited budget we have for the sensors and basic electronics of the project. Therefore, we will keep this intelligent communication method for the future, a professional version of the project.