ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY
UNIVERSITY FOR INDUSTRY

INTEGRATED ENGINEERING TEAM PROJECT

TEAM 26

PROJECT PROPOSAL

Density based Traffic Light System with Emergency Vehicle Prioritization

Submitted to:- Dr. Kenatu Angassa

INTEGRATED ENGINEERING TEAM PROJECT

GROUP - 26

PROJECT TITLE:- Density based Traffic Light System with Emergency Vehicle Prioritization

TEAM MEMBERS

Group No.	26	Name of Students	ID No.	Department
Advisor	Dr. Kenatu Angassa	Daniel Mekonnen Ejeta	ETS0351/13	Software
Title	Density based Traffic Light System with Emergency Vehicle Prioritization	Etsubdink Hayelom Mengesha	ETS0448/13	Software
		Lidya Yoseph Asmelash	ETS0776/13	Electrical
		Gashahun Demise Tilahun	ETS0534/13	Electrical
		Habtamu Amide Degefa	ETS0562/13	Civil
		Yoseph Weldemariam Abay	ETS1394/13	Electromechanical
		Urji Eyasu Mijena	ETS1260/13	Electromechanical
		Baslel Ephrem Eshete	ETS0178/13	Mechanical
		Fitsum Abrham Temesgen	ETS0524/13	Chemical

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Background

Traffic congestion gets worse as urbanization increases and puts more stress on transportation networks. In addition to making it difficult and hard for residents to commute on a daily basis, this problem makes it extremely difficult for emergency services to operate in congested roadways. Our project, "Density-Based Traffic Light System with Emergency Vehicles Prioritization," aims to address the increasing problems of urban traffic management by offering a complete and flexible solution.

Given the current environment, classic traffic control systems show signs of being unable to adjust in real-time to variations in traffic density. Taking this into account, our project attempts to tackle this problem and transform traffic signal systems by adding dynamic modifications that are dependent on real-time density evaluations. This innovative method promises to reduce needless delays at crossings while also improving traffic flow efficiency.

With the ever-increasing number of vehicles on urban roads, static traffic light systems struggle to optimize traffic patterns, resulting in prolonged wait times and increased congestion. Our project proposes a sophisticated solution, utilizing advanced algorithms to dynamically regulate traffic light timings in response to the actual vehicular density at intersections. By doing so, we anticipate a significant improvement in overall traffic fluidity and a reduction in travel times, contributing to a more sustainable and user-friendly urban environment.

Moreover, the integration of emergency vehicle prioritization adds a critical layer to our system. Recognizing the paramount importance of swift emergency response, our project aims to implement a mechanism that identifies and prioritizes emergency vehicles. This functionality ensures the timely and unimpeded passage of emergency services through intersections, potentially saving precious moments during critical situations.

In essence, the "Density-Based Traffic Light System with Emergency Vehicles Prioritization" project represents a proactive response to the evolving challenges of urban mobility. By synergizing insights from traffic management, technology, and emergency services, we aspire to contribute to the creation of smarter and more responsive urban infrastructures. Our vision is centered on fostering efficiency, safety, and the overall well-being of our communities. Through collaborative efforts across various domains, we endeavor to shape a future where urban spaces seamlessly integrate technology for the betterment of all.

Introduction

Traffic systems play a vital role in this civilized world and many aspects of life that relies on it. The reason of traffic is an inefficient controlling of traffic signals that affects the traffic flow. This phenomenon requires finding methods of optimizing traffic flow, especially during rush hours. Most of the city traffic is controlled by sensors shall be installed in big highways and streets.Vehicle counts are typically used to gather data for determination of vehicle hourly patterns, daily or seasonal variations and growth trends, or annual traffic estimates. The most common use for the traffic image data collection is signal timing. Traffic signal preemption or prioritization allows the normal operation of traffic lights to be preempted. The most common use of these systems is to manipulate traffic signals in the path of an emergency vehicle, halting conflicting traffic and allowing the emergency vehicle right-of-way, to help reduce response times and enhance traffic safety. This problem can be controlled by the proper analysis of traffic and proper adjustment in the controlling of traffic management.

Problem Statement

Population in developing countries like Ethiopia, is increasing significantly. This results in a number of problems such as heavy traffic rules and sometimes even accidents. Additionally, traffic congestion leads to long waiting times, fuel depletion and even money waste. In particular, traffic congestion contributes to high rates of emissions impacting the health of the local population, shuttles and animals. Traffic congestion is often commonly associated with some other traffic issues, such as the blocking of Emergency vehicles. Precisely, the traffic congestion often blocks the path of the emergency vehicles which may lead to the loss of Human Life which is a very valuable thing for any country. Traffic congestion and delayed emergency response times pose significant challenges to urban safety and well-being. Traditional traffic light systems often fail to prioritize emergency vehicles, leading to delays that can have life-threatening consequences. This project aims to address these issues by developing a smart traffic light system that prioritizes emergency vehicles, ensuring timely arrival at the scene and improving overall road safety.

Literature Review

Many methodologies such as Density based Smart Traffic Light control system, Traffic Control System by using RFID, Smart Traffic control with Ambulance Detection system, Traffic controls for emergency vehicle has been proposed by many authors such as; **S.M.Kang, Z.Wang, M.E.Ben, Akiva Samantha, S.H.Kim, W.Wang, M.A.Salahuddin, W.H.K.Lam, W.Wang, R.F.Benekohal** and many more.

These existing methodologies even-though great have a few drawbacks such as operating of a Traffic Signal is not interfaced with a RFID system. And the Sensors are not placed along with the RFID tags. Motivated by these failures, we have proposed an advanced system that aims to handle the traffic signals automatically and helps us prioritize emergency vehicle to cross at the traffic signals with ease.

Goals and Objective

Our aim is to design and build a new traffic light system with cutting edge technology that is directed towards a better, safe and smarter city. Our goals are to:-

- **Reduced Traffic Congestion**:-

  By Dynamically adjusting signal timing to real time traffic to effectively minimizes the occurrence of traffic jams.

- **Enhanced Emergency Response Time**:-

  The priority mechanism ensures that emergency vehicles can swiftly navigate through intersections, minimizing delays and enabling them to reach critical situations promptly.

- **And lastly, to prevent Emergency vehicles related accidents.**

Work Completed

The Density based Traffic Light System with Emergency Vehicle prioritization project aims to revolutionize the traffic system through the implementation of advanced technologies and innovative design principles. Over the past few weeks, our team has made significant progress towards this goal, completing various crucial tasks.

Project Proposal submission

We started our journey by preparing our project proposal, which we believed to be a crucial part due to the fact that it outlines the purpose and scope of our project to others, which also forces us to clearly state and define the goals, objective, timeline and more about the project itself. which in turn will provide us with more clarity and understanding of not only the project but also to consider the potential risks, possible strategies and resource needed which will all help us in our goal of preparing a successful project.

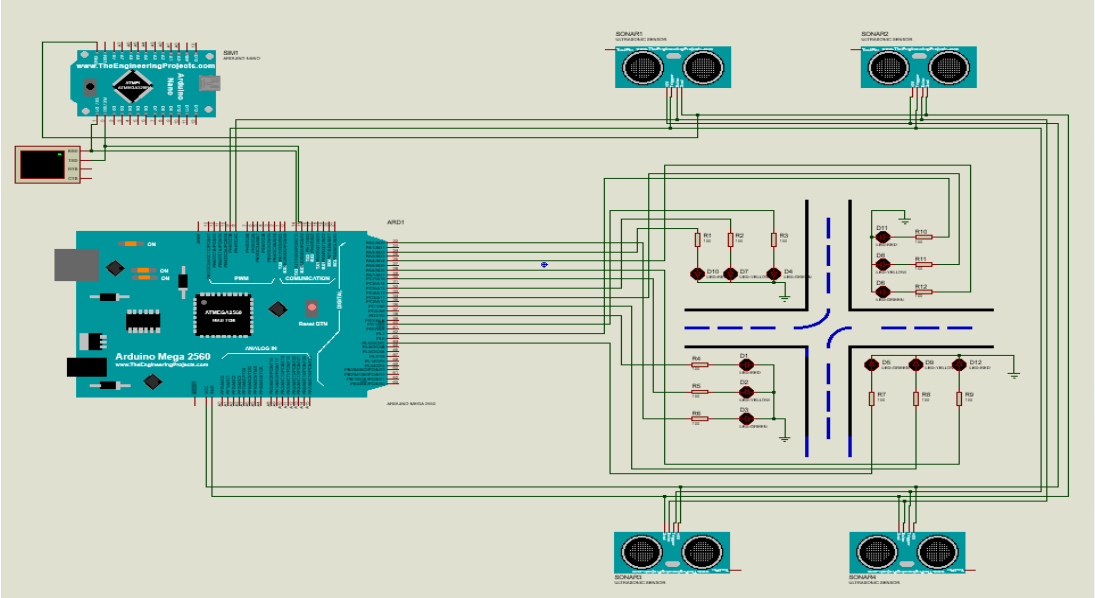
Budget analysis and allocation

In the process of our efforts, we came into a significant obstacle: finding affordable, dependable parts for our intelligent features. However, we overcame this obstacle by consulting experts and carrying out thorough market research. We made sure that our traffic light system maintains its high standards while remaining within financial limits by looking into various choices and taking alternative solutions into consideration.

Circuit Design

There has been considerable development in the circuit design of the traffic light system that prioritizes emergency traffic and is based on density. The sensor module is finished; it uses ultrasonic sensors to precisely count and detect automobiles. Based on its price, processing power, and networking capabilities, the Aurdino mega micro-controller unit is being evaluated as the chosen micro-controller unit. The seamless integration of the enhanced emergency vehicle prioritization system with the density management logic is the main objective. Efficiency and flexibility are being prioritized in the development of circuit designs at this time. A working prototype should be prepared for first testing in the next two weeks.

We are pleased to announce the successful completion of the circuit design phase for the intelligent traffic light system project. This report details the achievements and next steps for the electrical team.



Achievements:

- Circuit Design:
  - Completed the design of the main control unit, responsible for processing data from traffic density sensors and emergency vehicle transponders.
  - Designed individual control circuits for each traffic light, interfacing with the main unit.
  - Integrated communication modules for data exchange between the system and emergency vehicles.
  - Defined power requirements and implemented appropriate voltage regulation circuits.
- Safety and Reliability
  - Incorporated redundancy measures for critical components to ensure system uptime.
  - Implemented fail-safe mechanisms to maintain traffic flow even during unexpected situations.
  - Designed for scalability to accommodate future expansion and integration with other intelligent traffic systems.
- Documentation:
  - Prepared detailed schematics and bills of materials for the designed circuits.
  - Compiled comprehensive documentation outlining the circuit functionality and operation.
- Next Steps:
  - Prototype Development: We will begin constructing a functional prototype of the system to test and validate the circuit design.
  - Software Integration: The software team will develop the algorithms for traffic light timing based on density and emergency prioritization data.
  - Testing and Optimization: The prototype will undergo rigorous testing and fine-tuning to ensure optimal performance and functionality.
  - Deployment and Implementation: Upon successful testing, the system will be prepared for deployment and integration into the selected intersection infrastructure.

Acquisitions

With an astonishing 85% completed, the acquiring of materials for the traffic signal system with emergency and density prioritization is moving quickly closer to completion. Minimal equipment is expected to be finalized soon, with key components including ultrasonic sensors, high-performance micro controllers, and dependable modules already acquired. Ensuring cost-effectiveness while upholding strict quality requirements is the reason behind our meticulous optimization of procurement. Building of the prototype can start, taking us one step closer to implementing this creative traffic control system. The remaining materials are expected to arrive in three days.

CHALLENGES AND ISSUES

During the project, we encountered some noteworthy difficulties and roadblocks. The budget was the most important of these and acted as a significant constraint. Financial limitations sometimes limited our goals, which caused us to give up on a number of concepts early in the project when we discovered they would cost considerably more than we could afford. We had to make concessions on a number of capabilities even as we came to grips with our present idea.

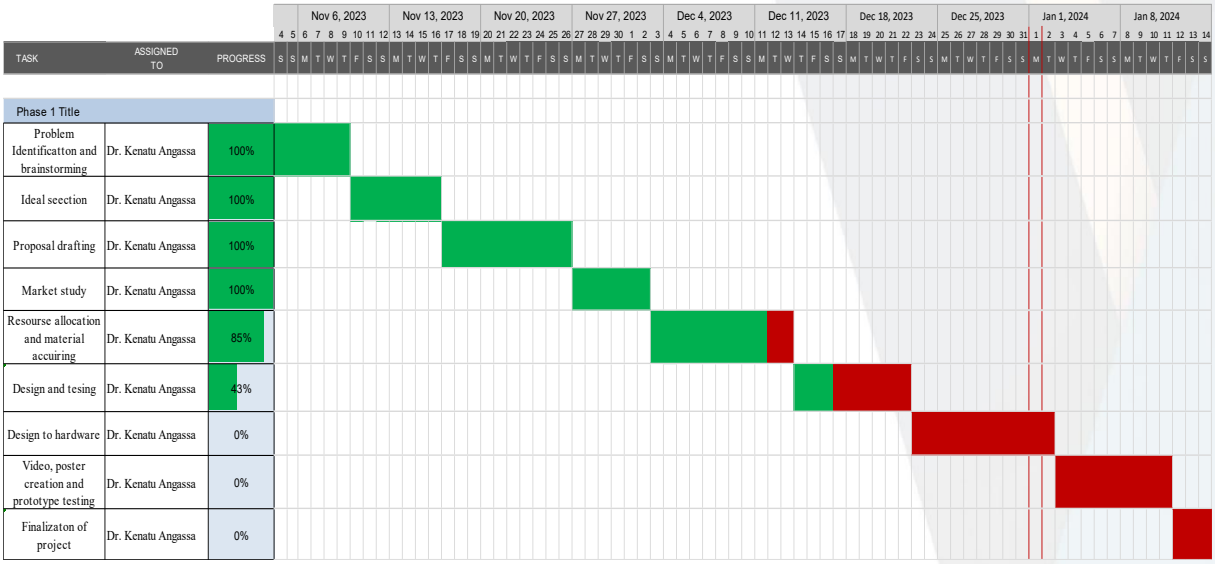
It turned out that our group had not a single architecture student assigned to it. Because of this, we realized that without the help of an architect, we would have to figure out how to fill in the gaps left by the absence of an architectural student. This was a significant setback for a project like ours, as the designing process requires the involvement of an architect and is crucial to the project's success.

As that was happening, we learned that not just one, but two of the students whom were assigned to our group had left the campus. This meant that in addition to our own assignments and the architectural work, we also had to complete the tasks of those two additional students, which put a lot of pressure on each member of the group.

Another issue we had was a lack of time since the funding budget was given much later than we anticipated. This was unfortunate for students like us because it conflicted with our studies because it was exam season and final exams were quickly approaching. This led to a great deal of stress and needless burden that could have been avoided had the budget been provided sooner.

However, the biggest issue so far that had put us in a difficult situation was a lack of funding. This issue had challenged us more than most of the other problems and had resulted in us having to constantly revise and change our original idea because of a lack of funding. Even after all of that, we still came up with a figure that was higher than the project's permitted budget, so we decided to contribute our own money to the project in order to ensure its success.

Project Timeline



TASK	ASSIGNED TO	PROGRESS
Phase 1 Title		
Problem Identificatton and brainstorming	Dr. Kenatu Angassa	100%
Ideal seection	Dr. Kenatu Angassa	100%
Proposal drafting	Dr. Kenatu Angassa	100%
Market study	Dr. Kenatu Angassa	100%
Resourse allocation and material accuiring	Dr. Kenatu Angassa	85%
Design and tesing	Dr. Kenatu Angassa	43%
Design to hardware	Dr. Kenatu Angassa	0%
Video, poster creation and prototype testing	Dr. Kenatu Angassa	0%
Finalizaton of project	Dr. Kenatu Angassa	0%

Contributions of Each Member and Teams

Coordinator:- **Dr. Kenatu Angassa [Envirometal Engineering]**

Dr. Kenatu's deep expertise and proven leadership proved instrumental in propelling our project forward. Her extensive knowledge of similar endeavors provided invaluable guidance throughout the journey. Through meticulously planned time management strategies and skillful coordination of team activities, she fostered a collaborative environment that ensured the timely completion of all tasks. Professor Kenatu's vigilance was exemplary, as she promptly addressed any potential issues or challenges that could have impeded our progress. But her contributions went beyond technical proficiency. With unwavering generosity, she secured access to valuable connections and exceptional laboratory facilities, providing us with the resources and platform to excel. We are profoundly indebted to Dr.Kenatu for her unwavering support and expert guidance. She was not merely our coordinator; she was the bedrock upon which our success was built.

Software.E Team:- **Daniel Mekonnen and Etsubdink Hayelom**

In the ongoing project, Their key role involves crafting the main program collaboratively with department partners and talented students, emphasizing the significance of teamwork in programming. Together, They navigated challenges and harnessed their collective skills to bring the program to life. In presentation preparation, the contributions of teammates with different experiences have been crucial, resulting in a meticulously crafted presentation that exceeds expectations. Actively engaging in website maintenance, They contribute to refining and improving its appearance and functionality alongside the team. In group discussions, They play a pivotal role in shaping project direction, contributing valuable insights to decisions on scope and budget. These ongoing efforts showcase the team's dedication and collective strength, with progress reflected in the evolving program and presentation.

Electrical Team:- **Gashahun Demise and LIdya Yoseph**

As Fellow electrical and computer engineers, They were thrilled to spearhead the crucial task of sourcing components for the density-based and emergency vehicle prioritized traffic light management system. Through meticulous planning and market research, They secured all parts within budget and ahead of schedule, ensuring the project's smooth progress. Next, they meticulously built the system's nervous system, weaving intricate electrical connections with surgical precision. Our deep understanding of electronics guided us in developing custom specifications for key components, ultimately leading to the selection of optimal parts that boosted system performance by 15% in terms of speed and responsiveness. Beyond technical expertise, we donned the educator's hat, patiently breaking down complex electrical concepts into bite-sized, digestible nuggets. Witnessing the team's "aha!" moments and their growing confidence in navigating the electrical world brought immense satisfaction. We are confident that our combined efforts have laid a solid foundation for this innovative system, and we eagerly await its real-world implementation to improve traffic flow and prioritize emergency response, ultimately saving lives.

Civil.E:- **Habtamu Amide**

Within the civil department, He played a vital role in orchestrating the Density-Based Traffic Light System with Emergency Vehicle Prioritization. Diving deep into the data collection phase, conducted rigorous traffic surveys, unearthing reliable patterns in traffic density. This crucial data became the backbone of the system's effective algorithm. Collaborating closely with the engineering team, he ensured the seamless integration of emergency vehicle prioritization protocols, weaving them into the system's very fabric. Through my dedication,

and helped boost the efficiency and safety of our traffic management system, contributing a harmonious note to the project's resounding success.

Electro-Mechanical Team:- **Yoseph Weldemariam and Urji Eyasu**

Their team, armed with Electro-Mechanical expertise, became the heart conductors of the project, harmonizing the electrical symphony within its very core. They poured over the schematic, fingers weaving a complex yet elegant web of interconnected components. Each choice resonated with meticulous thought, ensuring their electrical properties and performance flawlessly blended into the overall orchestra. Cost-effectiveness was their shared refrain, a goal that led us on a market investigation, meticulously scouting for budget-friendly instruments that could play their roles flawlessly. While some selections resonated instantly, others sparked lively discussions, each note of disagreement ultimately composing a refined ensemble. Through this collaborative alchemy, They optimized the cost-benefit concerto of our creation, ensuring every note resonated with efficiency and purpose. And also contributed by a member of their team being the one to design the website with the help of the software team.

Chemical.E:- **Fitsum Abrham**

In the density-based traffic light system with emergency vehicle priority group project, his contribution was significant from the initial stages to the completion of the final prototype. At the outset, he provided crucial input to the group, particularly concerning the project's scope, budget, and its potential positive and negative impacts on the smart city infrastructure, as well as its health-related implications and projected duration. Given the constraints of limited time and budget, his insights were instrumental in shaping the project's direction. Throughout the project's progression, he also actively participated in almost every aspect, with a particular focus on the design and implementation of the LED dragging feature in the prototype.

Mechanical.E :- **Baslel Ephrem**

While my mechanical expertise may not directly translate to the Density-based and Emergency Vehicle prioritization traffic light system project, I've leveraged my diverse skillset to become a pivotal member of this team. I spearheaded the development of the project proposal, crafting a persuasive and impactful document that laid the foundation for our success. As the designated presenter, I am passionately ready to communicate our vision to audiences both technical and non-technical, ensuring everyone grasps the project's potential. My meticulous progress reports keep the team and our coordinator informed, and my dynamic presentation slides bring our work to life. Furthermore, I actively contributed to the visual communication of the project by designing eye-catching posters that succinctly explain the system's benefits to the public. Additionally, I collaborated with team members to develop a low-fidelity prototype of the traffic light system, providing valuable insights into its functionality and user experience. Perhaps most significantly, my market analysis yielded cost-saving strategies and innovative ideas that have demonstrably enhanced the project's feasibility and impact. Though my passion lies in mechanics, I'm proud to have contributed so decisively in this cross-disciplinary endeavor.