iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** V **Month of publication:** May 2021

DOI: https://doi.org/10.22214/ijraset.2021.34064

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

Smart Traffic Control for Emergency Vehicles & Electricity Generating Speed Breaker

Dindayal R. Barishth[1], Himanshu J. Singh Bisht[2], Atul S. Dubey[3], Sahil K. Mallick[4], Iqbal Mansuri[5]
[1, 2, 3, 4]*Student,* [5]*Assistant Professor, Department of Mechanical Engineering, Theem College of Engineering, Boisar 401501*

Abstract: ***Due to increase in population and automobile industry worldwide, the number of vehicles on road has risen dramatically causing traffic issues on roadways. This leads to problems for emergency vehicles which can eventually result in loss of life and property. In tackling such unfortunate incidents, a smart traffic control system proves to be beneficial. This system uses RFID transmitter and receiver for detecting the presence of emergency vehicles on roads and accordingly manage the traffic to let the emergency vehicles pass safely and quickly and thus ensuring the rescue of life and property.***
Energy shortage is one of the major issues that the world is facing today, especially India. This problem has basically arisen due to excess usage of conventional sources of energy which ultimately led to the decrease in their supply to the world. One solution to this problem is by taking advantage of the increasing number of vehicles on the road. The kinetic energy of vehicles can be utilized to generate electricity by using an 'ELECTRICITY BUMP' or Special arrangement called 'SPEED BREAKER'. This phenomenon is possible through rack and pinion mechanism.
Keywords: Smart management system, RFID, EM18 Reader, Reverse polarity, traffic congestion

I. INTRODUCTION

The world's population has increased from 1.65 billion to 6 billion in 20th century. It has nearly doubled since 1970. Industrial Revolution is the main cause of this dramatic increase in population. Along with which came in the boom in automobile sector. According to industry analysts and experts, currently there are around 1.2 billion vehicles which would go up to 2.5 billion by 2050. Due to the increasing population, number of the vehicles on roads has increased consequently but this increase in number of vehicles proves to be advantageous when it comes to supply electricity. Energy crisis is one of the main problems in the world due to the declining natural reserves of non-renewable energy sources. However, this loss can be compensated if we make use of the automobiles on road. This paper attempts to show how electricity can be generated through the speed breaker.

Speed breaker plays very important role in slowing down the traffic and additionally it can be used to generate electricity. The rate of increase in supply of electricity is less than its rising demand worldwide. Thus, the amount of electricity generated must be increased.

At the same time, the resources which are used to generate electricity are also reducing. So, it is need of the hour to save the conventional resources and also to increase generation of electricity. The infrastructure of roads is lagging which causes traffic issues resulting in delay of Emergency services.

Also, there are hardly any provisions for notifying other drivers about approaching Emergency vehicles i.e. ambulance, police, fire brigades, etc. As these vehicles travel at higher speed, they are more likely to be engaged in road accidents. Researchers have come up with various methods to track emergency services and measure traffic density and then adjust traffic signals for clearing their route.

II. LITERATURE REVIEW

A. Smart Traffic Control for Emergency Vehicles

Kapileswar Nellore and Gerhard P. Hancke [(6)], proposed a visual sensing method to determine distance of an emergency vehicle from intersections.

Through experimentation Euclidean distance method was found to give most accurate distance measurements.

In order to minimize the delay in transfer of emergency messages PE-MAC protocol is used. NS-2 Simulations were performed to compare PE-MAC with IEEE 802.11p, Standard IEEE 802.15.4 and EBSS, which proved the betterment of transmission rate. Nearly, an improvement of 45% on IEEE 802.15.4, 16% on EBSS and 42% on IEEE 802.11p was attained in 60s transmission interval.

B. Electricity Generating Speed Breaker

Mr. Gunanithy.s, Prof. S.Nagarajan[7] In a roller mechanism, rollers square measure placed between a speed breaker (rotational bump shaft) that at the top transmit motion to the shaft of DC motor. This movement of the roller is employed to rotate the gear mechanisms. Rotating gears rotate the DC motor (which is employed as a generator). Hence, K.E. through the rotation of a motor gets reborn into its equivalent electricity. The electricity generated is then held on in an exceedingly battery which might lighten the road lights on the road or as per we would like.

Ramakrishna Prabu and G. Ethiraj[8], suggested 1 rack and 1 pinion design. This mechanism consists of a rack and a pinion which converts reciprocating linear motion into rotary motion. Whenever vehicle passes over the speed breaker the rack moves in downward direction and gives momentum to the pinion. The shaft of pinion is attached to chain and sprocket mechanism, which is made up of two sprockets- one big and another small. The Chain and sprocket arrangement transfers mechanical energy to the shaft below. Flywheel is connected to the same shaft of smaller sprocket which provides uniform angular motion to DC motor. When the pinion rotates in clockwise direction, only then the electricity is generated.

III. RESEARCH METHODOLOGY

A. Components for Smart Traffic Control System for Emergency Vehicles

1) EM 18 module

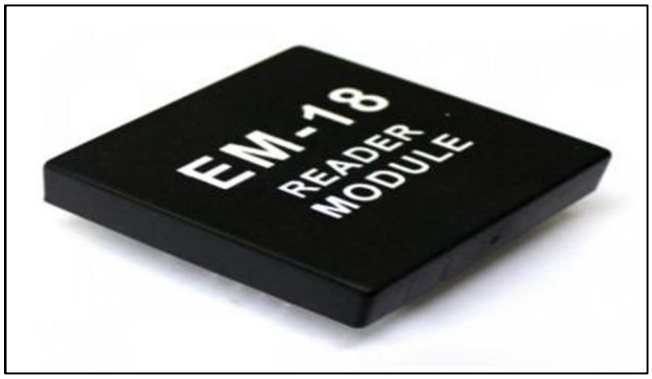


Fig. EM 18 module

EM-18 RFID reader is shown in fig. This reader senses the signal and forward to the next component of this design. This module is not so much costly and the data interpretation is also good.

2) RFID Tags

Fig. RFID tags

These cards are used to trigger the EM 18 module reader. These cards come with different frequency range and we have chosen according to our project. In our project, we have used four RFID Tags for four directions i.e. east, south, west and north respectively as shown in fig.

3) *Led Lights:* LED strips for divider to indicate the arrival of emergency vehicles. When an emergency vehicle installed with RFID tags pass through a lane, the LED lights in the divider will start glowing and it will inform the other drivers that an emergency vehicle is passing. Due to increased luminous efficacy and higher electricity SMDs, LED strip lights to be used in traffic lights.

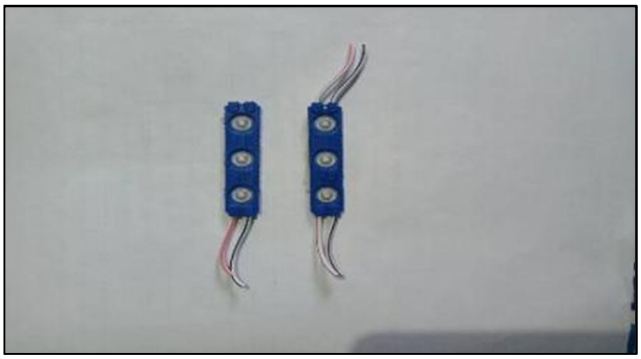


Fig. LED strips

B. *Components for Electricity Generating Speed Breaker*

1) *Rack and pinion*

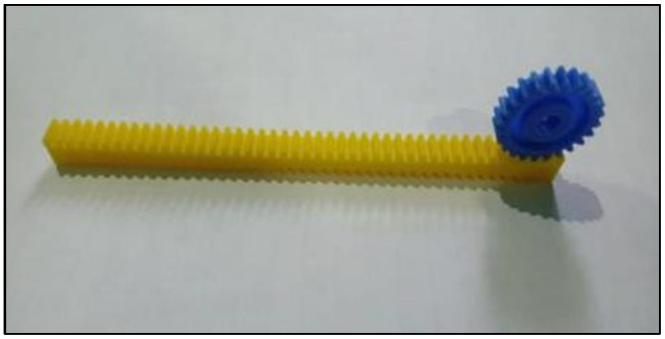


Fig. Rack and pinion

This rack and pinion are used in our project. The pinion is connected to speed breaker and the rack is vertically attached to the design. As the speed breaker moves down the pinion also come along with this and follow the path of rack.

2) *Dynamo*

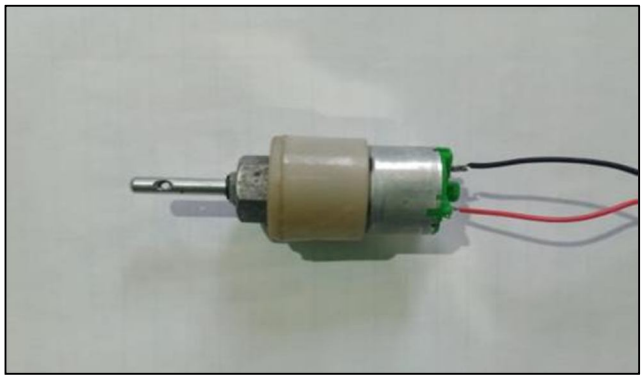


Fig.1000 RPM dynamo

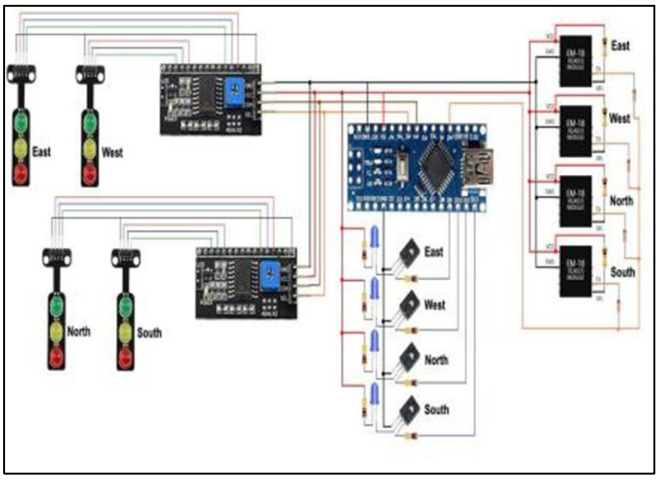
This dynamo is attached with the pinion and as the pinion are rotating the dynamo is also start and with the help of rotation dynamo start generating the electrical current and is stored in the battery.

3) Spring: This spring is used to avoid the damage of rack and pinion. And with the help of this spring speed breaker regain its original position

Fig. spring

IV. CIRCUIT DIAGRAM

A. Smart Traffic Control System



The connections of the components are as per shown in above fig the four LED lights representing the four directions are connected to four discrete pins in I2C. The GND, VCC, SQC and SCL terminals of I2C are connected to GND, 5V pins of Arduino nano respectively.

B. Prototype of The Design

The prototype of our design consists of a base of dimensions 55×30×10 mm. The circuitry work is installed inside the base and the LED traffic lights and divider lights are arranged on top of the base according to the respective directions as shown in below figure. Charging pin is also there in the west direction. But in the diagram, it is no visible.

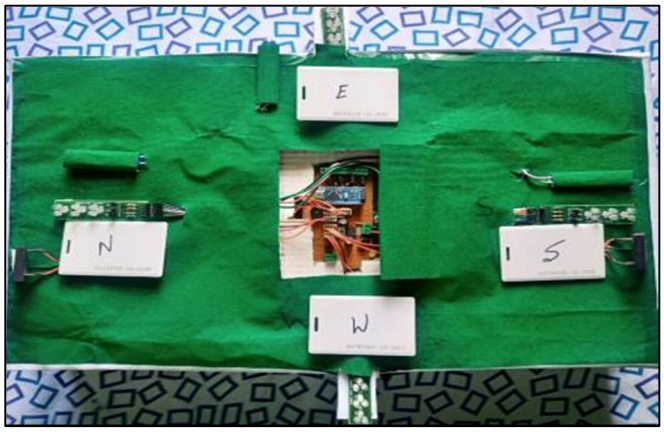


Fig. Prototype of The Design

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

Flowchart

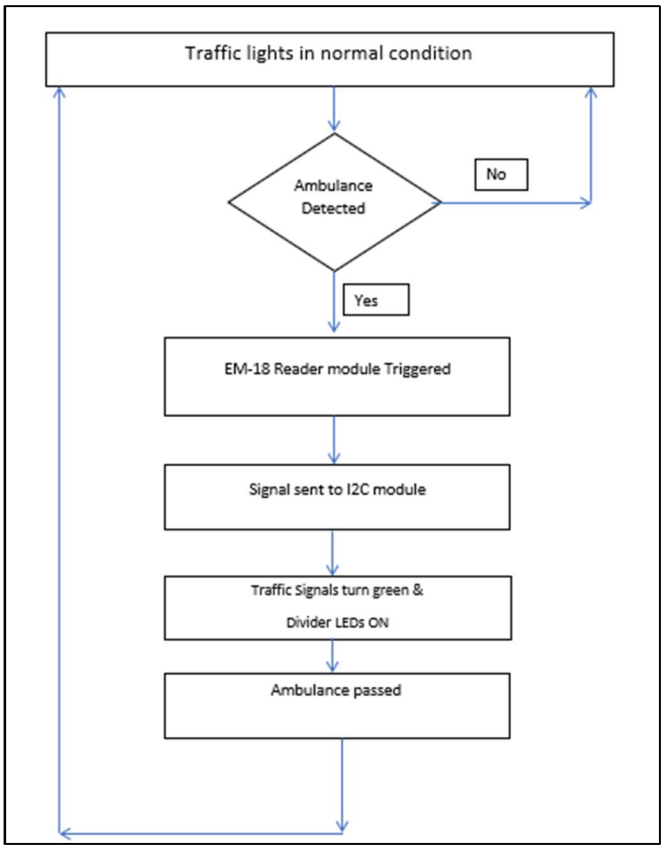


Fig. Flowchart

There are 2 cycles - Normal cycle and Emergency cycle.
In normal cycle Traffic semaphores switch in cycle of East-South-West-North-East. The delay of switching of one lane's green signal to another is about 10 seconds. Emergency cycle is activated only if RFID tag of a listed emergency vehicle is detected by an EM18 module. Herein after 5 second delay, normal cycle is terminated and the green signal of a lane is turned on as per the RFID tag detected. Also, the divider LEDs are turned on. After 10 seconds Normal cycle is again continued from where the sequence was left.

C. Electricity Generating Speed Breaker

Prototype of The Design

The below figure shows the basic prototype of our design.
We have attached the speed breaker to the spring. The rack is connected to the speed breaker which mates with the pinion on the dynamo.

Fig. Top view of the prototype

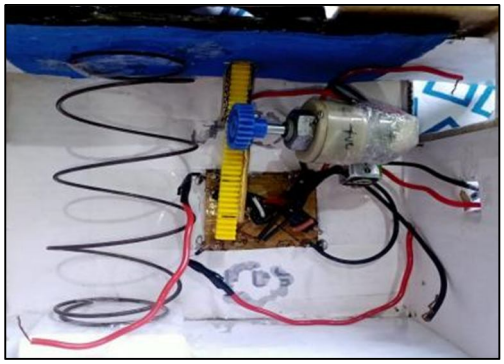


Fig. Inside view

To deal with the problem of battery damage and bulkiness we have introduced the polarity reversing mechanism in our design as shown below.

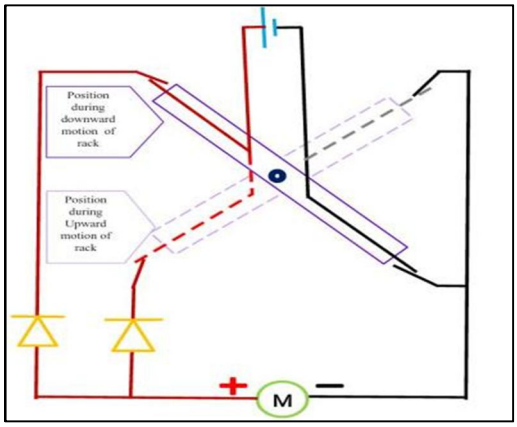


Fig. Reversing mechanism

Flowchart

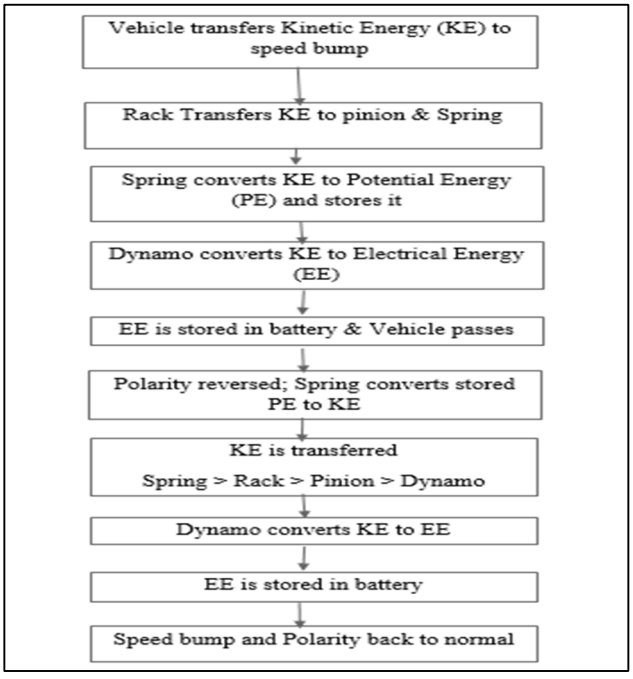


Fig. Flowchart

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

As soon as the vehicle presses the speed breaker, rack attached with speed breaker moves down thereby compressing the spring. The pinion attached with the shaft of dynamo rotates and electricity is generated. The electricity generated is stored in battery. When the vehicle's tyre passes, polarity of the system is reversed by polarity reversing mechanism. Now, in similar manner the spring's potential energy is utilized in generating electricity. At the end again polarity of the system is reversed to normal. Diodes are connected to prevent backflow of current back to dynamo.

V. DATA ANALYSIS AND RESULT

A. Smart Traffic Control System for Emergency Vehicles

In our project, we have used four signals for four different lanes i.e. east, south, west and north respectively. These signals were coded by using ARDUINO NANO and are also connected to EM-18 module.

Fig. Image of normal working cycle

As you can see in the above fig, when there are no emergency vehicles passing i.e. in normal cycle condition, first the red, yellow and green lights blink consecutively for 10 seconds each of the east lane. When the cycle of east lane ends, the lights of South lane blink in the same manner and accordingly the west lane and north lane perform the normal cycle too.

Fig. Emergency vehicle passes

Now, when an emergency vehicle passes through a lane, say west, containing RFID tag, it will be sensed by the EM-18 module and will give a signal to I2C module. The ARDUINO then process on that input and gives the command to the west lane traffic lights and also, the divider on west lane, which blinks on the lights. This is a prototype and we haven't applied this on any road. But by research we can define the result of this model. We have done a simple survey on highway conjunction for one hour.

In one hour, from conjunction there were around 15 ambulance were passed. And around 9 ambulance were passed normally means in 50-60 sec from the conjunction. And rest 6 ambulance taken 90 sec to 150 sec to crossed the conjunction. But in place of conventional system if we have used our smart traffic system in that condition around 14 vehicles can passes within 30-40 sec.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue V May 2021- Available at www.ijraset.com

B. Result

In order to determine the amount of electricity generated due to speed breaker, we counted the number of vehicles passing over the speed breaker for 15 minutes four times in a day i.e. for one hour. After counting the number of vehicles at different times, we found out that on an average 400 vehicles passed over the speed breaker in an hour. Let's assume that the average mass of vehicle is 400kg. The height of the rack is 14cm, the diameter of final pulley is 18mm and having revolution speed of 37 revolution per minute. Electricity is generated due to the downward and upward motion of the speed breaker that is produced with the help of springs and polarity reversing mechanism.

Force= F= m*g
F= 400*9.8= 3920 N
r= 9mm= 0.009m
T= r*F
T= 0.009*3920= 35.28Nm
Mechanical Power, P= T*(2πN/60)
P= (35.28*2π*37)/60
P= 136.62W

Mechanical Power is equivalent to Electrical Power.
This electricity is generated only for the downward motion of the rack. Therefore, total electricity is combination of both upward and downward motion.

Total electricity = 2*136.62= 273.24W
We also noted the electrical energy generated and stored in battery with help of a digital multimeter.

The results are as follows:
400 revolutions charged 0.4 volts of battery
Hence 1 revolution → 0.4/400 Volts
1 revolution → 0.001 Volts

As we know, In our prototype
1 Revolution = 1 Complete downward/upward motion of rack
1 revolution → 1 Milli Volts
Since 2 revolution of pinion is equivalent to frontend tyre of vehicle passing over speed breakers and as there are 2 sets of tyres in any two-wheeler or 4-wheeler vehicle i.e., front & rear end tyres. 4 revolutions of pinion occur from every vehicle passing. Hence every vehicle charge 4 millivolts of battery approximately.
As per assumption of 400 vehicles passing on average per hour.
Total charging from 400 vehicles per hour = 1.6 volts per hour

VI. SUMMARY

In modern days, due to heavy traffic on roads, the human life is at a risk as the emergency vehicles find it difficult to pass through the heavy traffic. This project implements on the design of smart traffic control system that helps for smooth motion of cars/vehicles on the transportation routes. We have proposed a system based on EM-18 module and RFID tags that senses the passage of an emergency vehicle and also give a prior indication to the other vehicles using LED lights on the divider. This heavy traffic is not as disadvantageous as we think. Since the number of vehicles is increasing day by day, we have proposed a design that will convert the kinetic energy of the vehicles into electrical energy to deal with the problem of energy shortage. Our mechanism consists of a rack and a pinion converting linear motion of speed breaker into rotary motion of dynamo shaft which will rotate in the magnetic field cutting the magnetic lines of forces thus producing electricity.

VII. CONCLUSION

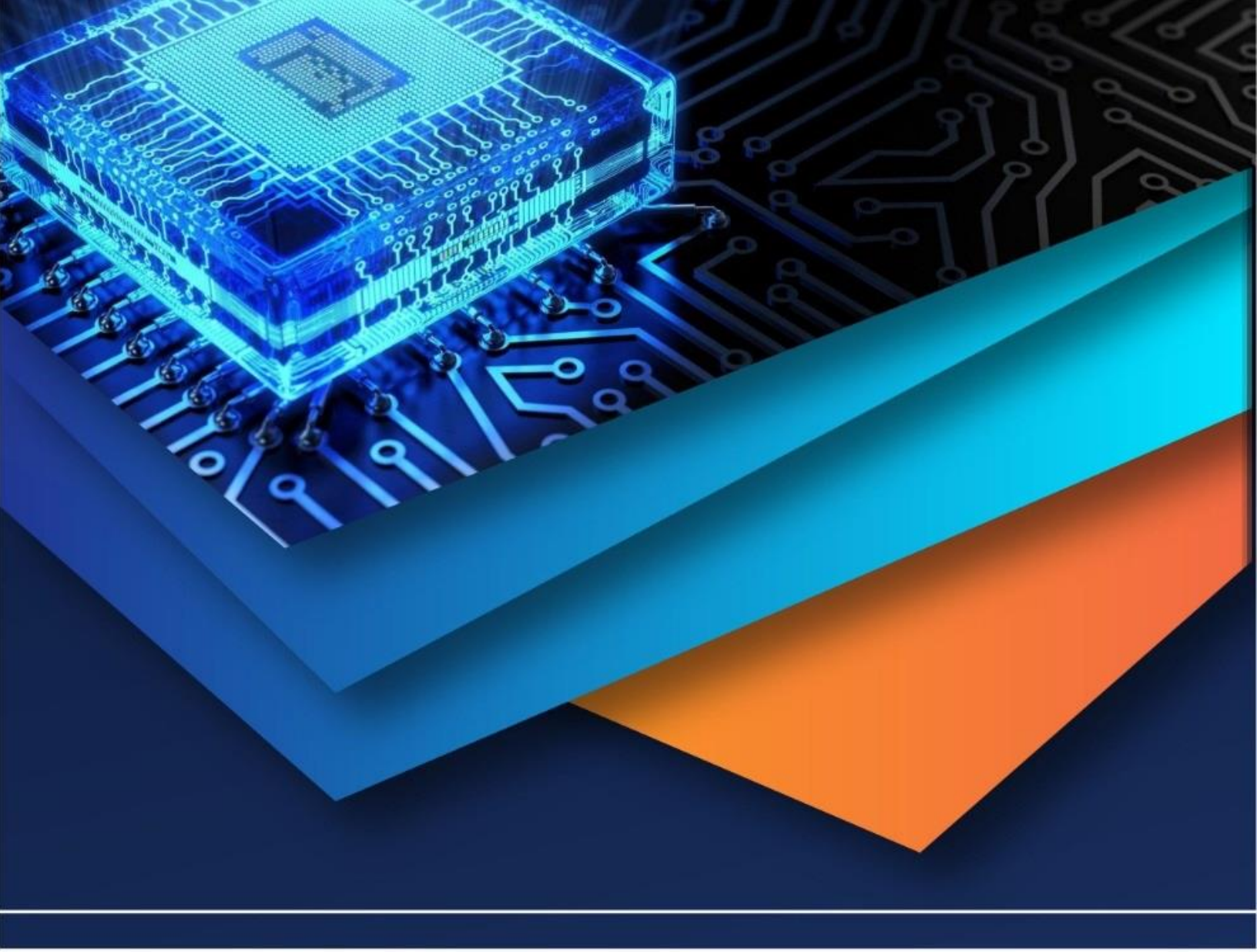
While working on this project, we got to learn a lot about sensors and modules. First, we studied about those concepts theoretically and then tried to implement it practically, however, it was quite a challenge as we had to go through a lot of trial and error methods during the coding. There were a wide range of sensors we could use but depending on our design, the best module we chose is the EM-18 module and RFID tags because of its long range and compatible sensitivity. So, we have successfully completed the 'Smart Traffic Control System for Emergency Vehicles'. As for the 'Electricity Generating Speed Breaker', the basic aim of the project was to generate electricity by speed breakers to compensate the shortage of energy in today's world. It is recommended that everyone should understand this type of renewable energy and should use to household works or commercial one. This method can be implemented widely especially in metropolitan areas.

VIII. FUTURE SCOPE

A. Suitable for traffic system, streetlight, or anything which consume less power.
B. It can be used to charge batteries and used them to light up the streets.
C. If the load on speed breaker increases, the output of generator increases and hence it is more suitable on highways, flyovers, etc.
D. More suitable design can increase efficiency.

REFERENCES

[1] Kapileswar Nellore, and Gerhard P. Hancke [(6)], "Traffic Management for Emergency Vehicle Priority Based on Visual Sensing," in sensors 2016, Published on 10 Nov 2016.
[2] Mr. Gunanithy.s, Prof. S.Nagarajan [(7)], "Simulation of power generation from speed breakers using roller mechanism," in IJESRT, Gunanithy, 5(5): May, 2016] ISSN: 2277-9655.
[3] G.Ramakrishna Prabu, G.Ethiraj [(8)], "Electricity Generation by Speed Breaker," in International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, ISSN (Print) : 2320 – 3765,Vol. 4, Issue 5, May 2015.
[4] Varsha Srinivasan, Yazhini Priyadharshini Rajesh, S Yuvaraj and M Manigandan [(9)], "Smart traffic control with ambulance detection," in 2nd International conference on Advances in Mechanical Engineering (ICAME 2018), doi:10.1088/1757-899X/402/1/012015.
[5] Ashwini Kumbhalkar, Amruta manukar, Asmita Jadhav, and Anup Ingle [(10)], "Emergency ambulance route clearing system," in International Journal of Electrical, Electronics and Data Communication, ISSN: 2320-2084 Volume-4, Issue-7, Jul.-2016
[6] Manav Kandhari and Svetlin Antonov [(11)], "Smart traffic control system for ambulance," in https://www.researchgate.netpublication/315565890, Sept 2016.
[7] Ali Azama, M. Aqeel Aslamb, Shoukat Alia, F.Q. Yousef-Zaib [(12)], "Speed Breaker Power Generator," in 4th International Conference on Energy, Environment and Sustainable Development 2016 (EESD 2016), https://www.researchgate.net/publication/314213735, Nov 2016.
[8] Jude Ezechi Dara, Christian Munachiso Odazie, Paul Chukwulozie Okolie, Andrew Onyemazuwa Azaka [(13)], "Design and construction of a double actuated mechanical speed breaker electricity generator," in Heliyon 6 (2020) e04802, https://doi.org/10.1016/j.heliyon.2020.e04802, Received 21 December 2019; Received in revised form 26 March 2020; Accepted 24 August 2020 2405-8440/© 2020.
[9] Mohamad Ramadana, Mahmoud Khaleda, and Hicham El Hage [(14)], "Using speed bump for power generation –Experimental study," in the 7th International Conference on Applied Energy – ICAE2015, Mohamad Ramadan et al. / Energy Procedia 75 (2015) 867 – 872.
[10] Akash Liladhar Gorle, Akash Narendra Patil, Akshay Vilasrao Thawale, Shridhar Vinod Giri, Brinda Darjee,and Leena . H. Patil [(15)], "Literature Review on Electricity Generation using Speed Breaker," in International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE) Vol. 7, Issue 10, October 2018, ISSN (Online) 2278- 1021, ISSN (Print) 2319-5940.
[11] https://www.researchgate.net/publication/260833477_Smart_Traffic_Management_System
[12] http://scholarsmepub.com/wp-content/uploads/2017/06/SJEAT-25192-196.pdf
[13] https://www.greencarreports.com/news/1093560_1-2-billion-vehicles-onworlds-roadsnow- 2-billion-by-2035-report
[14] https://www.worldometers.info/world-population/
[15] https://medium.com/@bkshashi9/ambulance-stuck-in-traffic-scaryright7b539ce518b9#:~: text=Unfortunately%20about%2030%25%20of%20deaths, to%20patients%20stuck%20in%20traffic



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY