Over Speeding Tracker

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***Abstract*— Road accidents have been very common in the present scenario of the world, and this is mainly caused due to careless driving. One such cause is the over-speeding of the vehicle. There has been a proposition in the governing bodies to prevent these road accidents by using the latest microprocessor technology. Many people are willing to know the speed limits of the road on which they are traveling so that they wouldn't exceed the speed limit and no such penalties are imposed on the users. There is a need to develop a device that satisfies all the above requirements. The prime objective of the project is to give an indication to the driver and alert him if he exceeded the speed limit of the road on which he is traveling. The project mainly consists of three categories: - Speed detection; GPS tracking; Indicating (or) Alarming. Speed detecting device work on the principle of Hall Effect using Hall Effect Sensor. The sensor detects the speed and transfers the information to the Arduino. Here the Arduino contains a GPS tracking map where all the information regarding the speed limits of each road has been uploaded. The device compares the speed of the vehicle at that instant to the speed limit on the map. When the vehicle exceeds the specified speed limit, an indication in the form of LED light and buzzing sound will be given there-by alerting the driver of the vehicle. This device can prevent major road accidents due to over-speeding of the vehicle. This project can also be modified with particular add-on's which focus on terrains and also the pothole tracker which helps to locate potholes and report them as well as indicating the accident-prone areas.**

Keywords — Over Speed Alert, Hall Effect sensor, I2C implementation, Arduino Uno, Arduino board, GPS module, LED, Road safety device

I. INTRODUCTION

A serious cause for concern across the Indian subcontinent is road accidents. The country reported about 151 thousand deaths due to road accidents in 2018 alone. Over 3 to 5 percent of the nation's GDP has been spent in road accidents last year. Notably, while India reported for about one-hundredth of the world's population of automobiles, this even accounted for about six percent of road traffic accidents across the world.

Young Indians were involved in almost 70 percent of the incidents. The probability of an accident and the seriousness of injuries during an accident are multiplied by increased speed. Faster vehicles are more prone to accidents than slower vehicles and in the case of faster vehicles; the severity of accidents would also be more severe. The vehicle requires some distance to stop, i.e. braking distance. A slower vehicle allows quick halting, while because of the laws of motion, a swifter one takes ways to avoid and often skids an extended distance. A high-speed car will have a greater impact during a head-on collision and will thus cause more casualties. When traveling at a relatively high pace the ability to assess the upcoming events is also diminished, resulting in an error in making a decision and eventually a wreck.

II. BACKGROUND AND RELATED WORK

Components used

1. Hall Effect Sensor

   Hall Effect sensor is a sensor that senses the magnetic field when a magnet is in the vicinity of it, the project incorporates a wide use of this sensor, and specifically the speed of the vehicle is obtained with this sensor. The code is written provides the output i.e. the specific speed of the vehicle. The overall project is built on the idea of the Hall Effect sensor.

Fig-1 Hall Effect Sensor

2. GPS Module

   GPS module is a device that uses satellite data to track ground positions, where a module and an antenna are provided. On plugging into the device, the obtained data (data such as latitudes and longitudes, time, altitude) is in the form of NMEA (National Marine Electronics Association) sentences. The location coordinates were extracted from the NMEA sentences using a code, which is further used in the project.

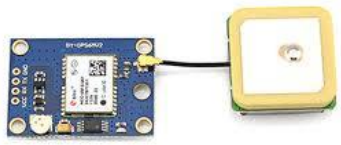

Fig-2 GPS Module

3. Arduino Board

   Arduino Uno is a microcontroller based on ATmega328p. It is one of the most user-friendly and widely used. The project uses Arduino which is the core and everything is built with it. The components used are tested and used with Arduino. It provides a range of digital and analog pins, accommodated with 6 PWM pins.

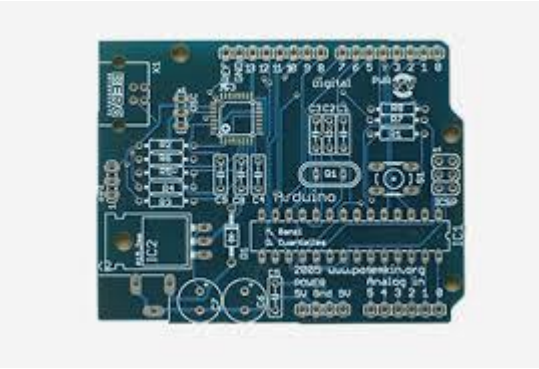

Fig-3 Arduino Board

III. PROBLEM SOLVING AND METHODOLOGY

A. Primary Survey

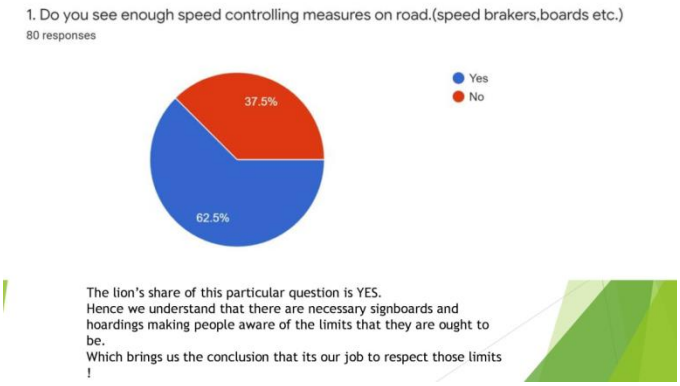

Fig-4 Primary Survey on road safety: awareness and behaviour (a)

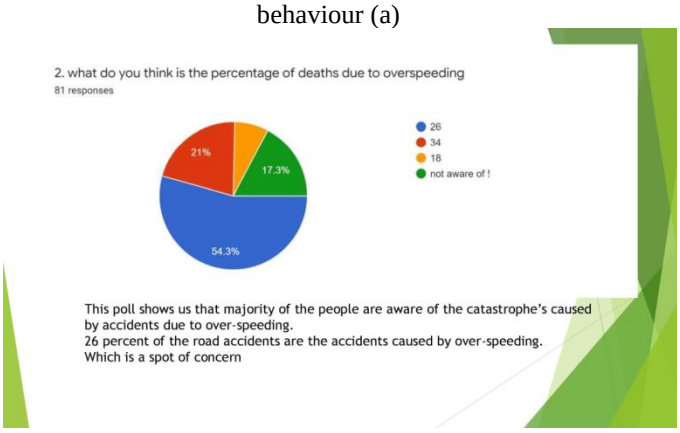

Fig-5 Primary Survey on road safety: awareness and behaviour (b)

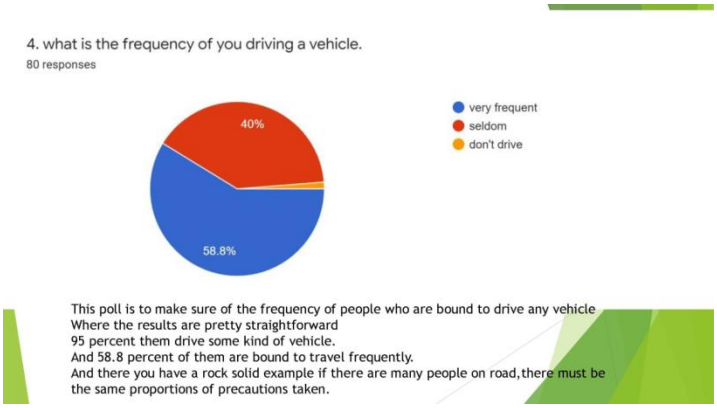

Fig-6 Primary Survey on road safety: awareness and behaviour (c)

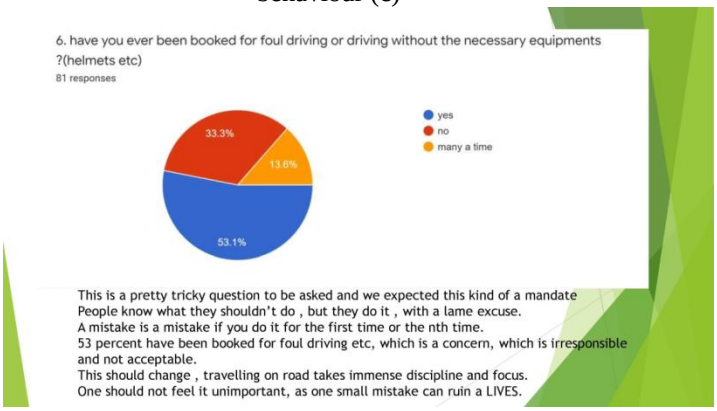

Fig-7 Primary Survey on road safety: awareness and behaviour (d)

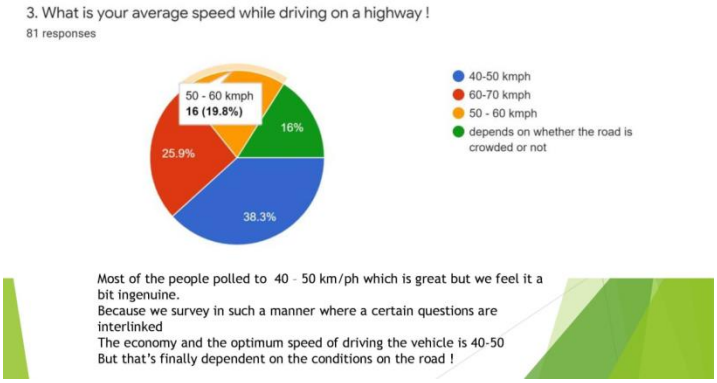

Fig-8 Primary Survey on road safety: awareness and behaviour (e)

B. Secondary Survey Report

Hall Effect Sensor varies output voltage in response to a magnetic field. Hall Effect devices are used for calculation of instantaneous speed[3]. When a car moves before the sensor it gives the output to Arduino, Arduino detects the falling wave, and therefore the speed is measured by the D-T relationship. The tracking system includes a sensor mounted, a communication link, and a GPS receiver. The raw satellite measurements with relevant timing and standing info are provided to the communication link [7]. Speeds on low urban streets often exceed the operating speeds. Hall Effect Sensor can measure a

pulse signal precisely and rapidly, has low-cost hardware, algorithm [1]. The experiment demonstrated good results where the speed detection is approximately 90% . The existing measures to limit over-speeding have not shown a major contribution to road safety [4]. With a speed warning system, drivers may pay more attention to the precise speed, which might be expected to extend glances to the speedometer [5]. The Over-Speeding system calculates the speed and GPS coordinates continuously and therefore these coordinates help us to seek out the world within which the vehicle has been present and the maximum speed within the respective area [2].Road traffic injuries are predictable and preventable, but good data are important to know the ways during which road safety interventions and technology will be successfully transferred from developed countries where they need proven effect [12] . Awareness of the implications of road traffic injuries is lagging among policymakers and therefore the general public. What's the need for the incorporation of comprehensive road safety programs into national planning in developing countries [11].

Drawbacks:

1. The solutions that exist now are not actively seen, the reason is that they aren't cost-effective.
2. The main drawback is the accuracy of measuring the speed. 90% is the accuracy noted in one of the articles, but that can degrade as time goes on.
3. There may be a case that the GPS may not work due to any technical issue and the driver may be in a problem.
4. This solution is on the magnetic property, hence there can be wear and tear after completing a certain time.
5. Simultaneous detection and communication must be done, but they can be prone to some technical issues, and some wear and tear.

C. The Empathy Map

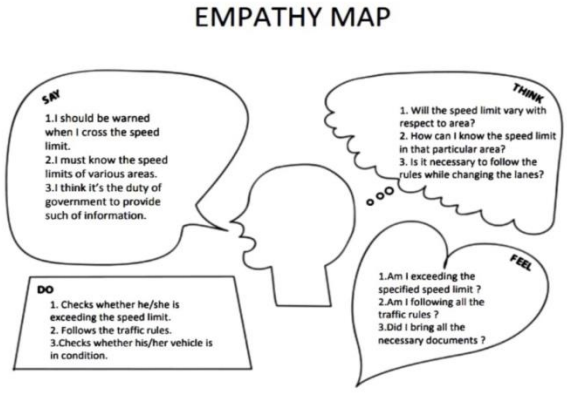

Fig-9 Empathy Map

D. Story

It's the morning dawn, Ravi and his family are up and in the hope of a brightening day, just as the sun brightens the dawn. Ravi is a poised person and goes through his routine nonchalantly. He works in a company where he feels very assured and is very contended with his routine in the job. He has a supporting family with his spouse being an artist, his kids a girl and a boy aged 16 and 20 respectively. His office is a mere 15 far, and he travels by car or motorcycle depending on the circumstances. So one day just as every day, Ravi is off to his work, and his wife and kids being at home. He reaches the office and gets to his routine. At the afternoon session, he gets a call from his wife saying "why don't we go for dinner tonight, it would be fun. We will have an enjoyable evening "Ravi has no hesitation in accepting it and followed by saying that he would complete his work soon and leave for home. So it's evening and Ravi hasn't been able to finish his work and in the back of his mind, he knows that he has to reach his home as soon as possible, otherwise his family would be disappointed. So when the work gets completed, Ravi is already late by an hour and he is off to his home, and now has to compensate for the delay he made. What might he do?! Does he compensate for the delay on road on the bike like a road racer, (which is not what he does normally?) On the other hand, it's the evening twilight, Bhaskar a 32-year-old unmarried man, was in a hope that his melancholics would dim-up just like the sunlight in the twilight. He is an unorganized person, does the things that give him please momentarily. He is a struggling person, struggling to make both ends meet, and was a driver who was axed for his rash driving skills, which he wasn't aware of. He is not a hurting person, but his instincts are sort of risk-taking. Bhaskar has this carefree attitude which irks people and unfortunately was punished on the road several times for his instincts. So one day, an agitated Bhaskar gets a call from his friend, saying that they would have a party and enjoy their time. Bhaskar who is in some sort of plight saw this as an opportunity to get free and have a change in mind-set. He is off in his bike, carrying his inborn freewheeling instincts. Now, Bhaskar is in search of pleasure, he is on road, what might he do? Drive like a road-racer which he is known of doing? Now Ravi was off to his home, and on the way, it was traffic all around, which added salt to the wound, and after some time he saw a less crowded highway, his eyes lit up, and unintentionally….bearing to situations he raised the accelerator, and to his inevitable fate, a pedestrian appeared suddenly crossing the road, and Ravi was out of the control, a fierce cut ensured him hitting the divider that's topsy-turvy in seconds. Bhaskar with his instincts was off happily and squeezing through the gaps between the cars, and to his bad plight this is a feather to his cap, sand was all over the ground and Bhaskar slipped with a minute of control in his hands hit a divider on the road. That's topsy-turvy in seconds! This is unpredictability! One never intended to over speed, the other guy, it was his instincts.

The result Over-speeding is unpredictable, you might have the pleasure momentarily, but on contemplation, it would be melancholy!

"Before you over speed
Think about over-speed-death!"
What might we do?
It is the question that remains!

E. How Might We Solve The Problem

1.) REDUCE THE NO.OF ACCIDENTS ?
2.) FOLLOW THE SPEED LIMITS ?
3.) MEASURE THE INSTANTANEOUS SPEED ?
4.) MAKE USE OF TECHNOLOGY IN MINIMIZING THE ROAD ACCIDENTS
5.) PREVENT THE DISTRACTION OF THE DRIVER ?
6.)TRACK THE LOCATION ?
7.)ALERT THE DRIVER ?

Fig-10 How Might We Questions

F. Ideation Table for proposed ideas

Idea	Human Desirability	Bussiness Viability	Technical Feasibility
Hall effect sensor	Yes	Yes	Yes
Arduino	Yes	No	Yes
Roadside sensors	Yes	Yes	Yes
Doppler effect	Yes	No	Yes
Gps	Yes	No	Yes
Map dumping	Yes	No	Yes
Crowd density measurement	Yes	No	Yes
Banking of roads	Yes	Yes	Yes
Pot hole detection	Yes	No	Yes
Types of indication	Yes	Yes	Yes

Fig-11 Ideation Table for proposed ideas

G. Need-Approach-Benefit-Competition (NABC) Approach

- Need

  Many surveys suggest that there are not enough measures taken on the roads to alert the drivers and reduce the number of accidents. People driving on roads are not aware of the speed limits and the accident-prone areas they might approach. So every driver needs to get the alert to prevent accidents and also to ensure safe traveling.

- Approach

  A real-time alerting device with a speed tracker helps in notifying the driver instantly. The speed of the vehicle will be compared to the speed limit of that particular road which has to be preloaded. This enables the driver to get notified with the help of an LED or an alarm when the speed exceeds its threshold and thus making the journey comfortable.

- Benefit

  Project main motto is to alert the driver if he/she crossed the speed limit of the certain road on which he/she has been traveling. By this, the number of accidents can be reduced. With a real-time tracker, the speed limits of all the roads on which the driver is traveling can be provided and also alerts the driver ahead of accident-prone areas.

- Competition

  Idea/Project is a generic one. So the problem is faced by almost every individual every day. So as far as competition is concerned it might be huge comparatively. It varies from established companies to us. Aiming to make it effective from the budget point of view, and execution. Presently, there aren't many projects seen, so as far as concerned it ensures the safety of the vehicle and enables one to follow the traffic rules.

H. 2X2 Matrix for various components

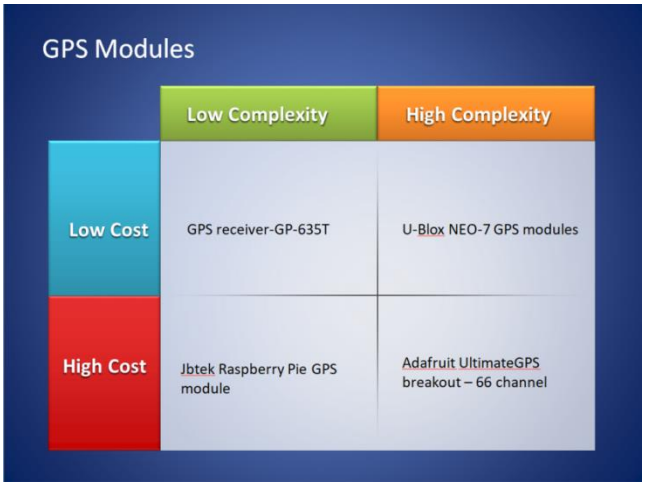

Fig-12 2X2 Matrix for GPS module

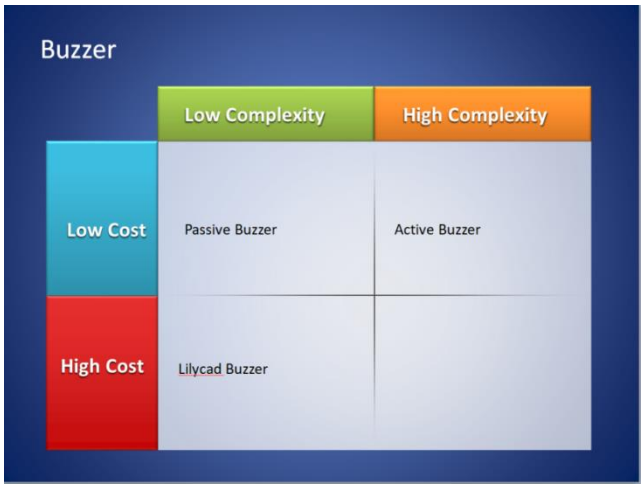

Fig-13 2X2 Matrix for buzzer

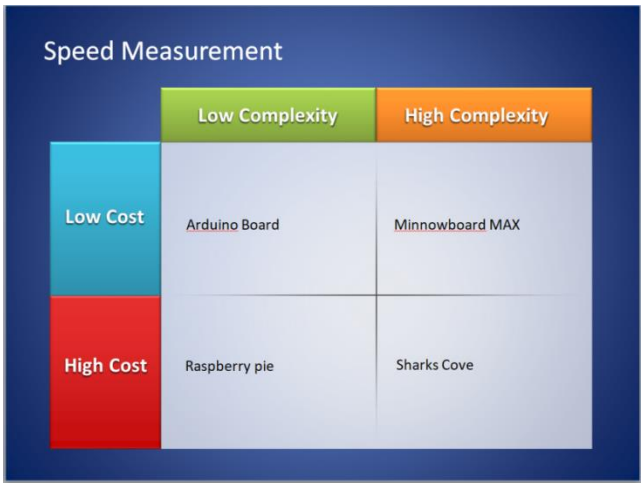

Fig-14 2X2 Matrix for various methods of speed measurement

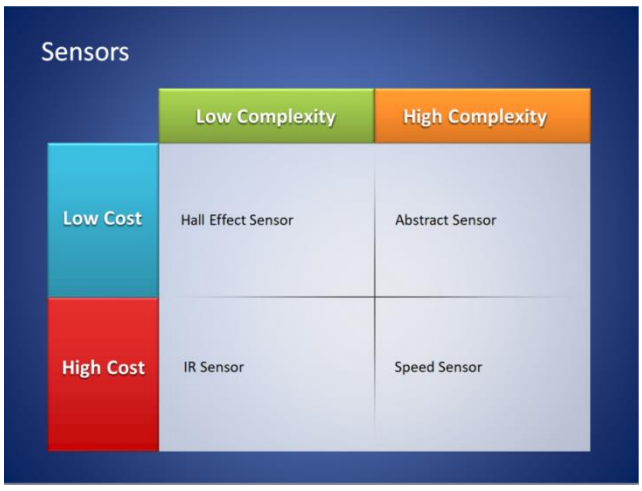

Fig-15 2X2 Matrix for sensors

I. Flow chart showing the working of the over-speeding tracker

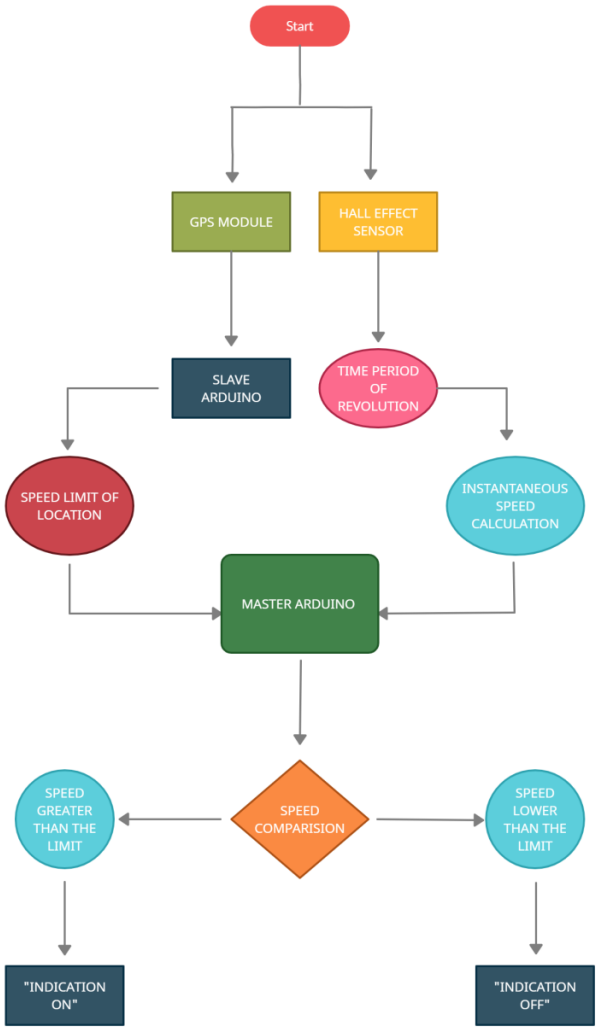

Fig-16 Flow chart showing the working of the over-speeding tracker

IV. PROTOTYPE PHASE

A. Testing of code for various components in Arduino IDE

The Hall Effect sensor with the help of a magnet can be used to obtain the time taken to complete one revolution of an automobile's wheel. This can be later computed to obtain the real-time speed of the vehicle instantly. The following code includes the Hall Effect sensor as the input device and the required calculations are performed by measuring the circumference of an automobile wheel and the time taken by it to complete one revolution(from the Hall Effect sensor).

A stepper motor is useful as a constant speed object since it is very difficult to run an automobile at a constant speed. The following code makes the stepper make stepper motor run at a constant speed and the speed is measured with the Hall Effect sensor.

B. Computation of speed using the Hall Effect Sensor (Constant speed of a stepper motor)

The Hall Effect sensor and the stepper motor are assembled on an Arduino Uno. The stepper motor is made to rotate at a constant speed using the above code.

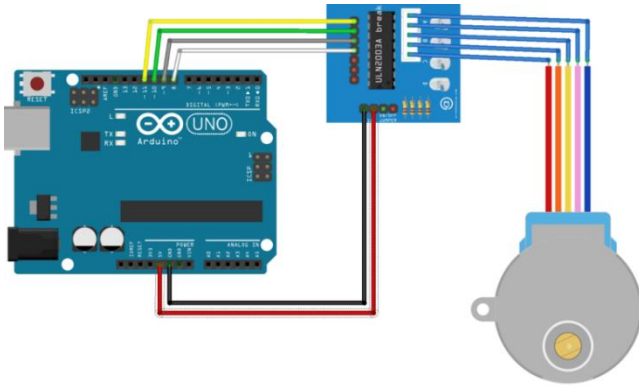

Fig-17 Stepper Motor

The time taken for two revolutions is given by the Hall Effect sensor. With the help of the time and the circumference of the wheel, the corresponding speed is computed using the code.

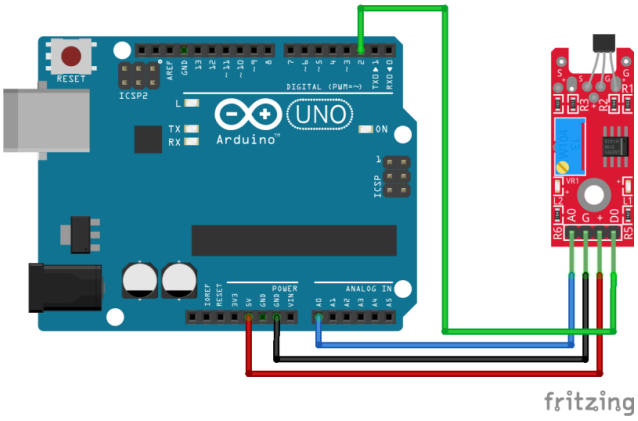

Fig-18 Hall Effect Sensor

C. Computation of variable speed and alerting the user with the help of an indication

An indication such as an LED or a buzzer is assembled with the components to alert the user whenever the real-time speed exceeds the threshold limit set the standards or the user himself. The indication continues to alert the user till the real-time speed drops below the threshold speed.

Note: Varying the speed of the stepper motor is a complex task, so the time of the revolutions can be increased by excluding two or more revolutions. So that the corresponding speed change is noticeable. While assembling the components, the stepper motor is given a separate power supply so that the voltage drop does not occur and the indication does not get affected.

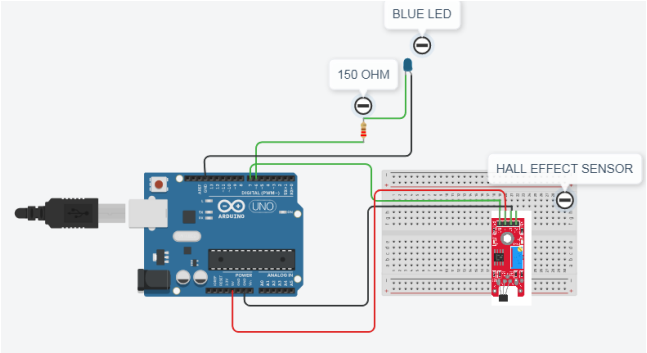

Fig-19 Hall Effect sensor with the indication

D. Obtaining the speed limits at different places using a GPS module

The GPS module gives the location in the National Marine Electronics Association (NMEA) sentence format. It is very difficult to set the speed limits in this format. So, the NMEA code is converted into a format that consists of latitudes and longitudes in the form of floating values, and hence the speed limits can be easily set within an area.

To connect the GPS module with the existing components, serial communication between two Arduino boards is established using the Inter-Integrated Circuit (I^2C) Protocol. The Hall Effect sensor along with the indicator acts as a "Master" in the device circuit while the GPS module (Arduino) itself acts as a "slave" in communicating the speed limit with the Master board.

With the communicated speed limit data and the calculated real-time speed with the help, of the Hall Effect sensor, the Master board controls the indicator whenever the threshold speed is exceeded.

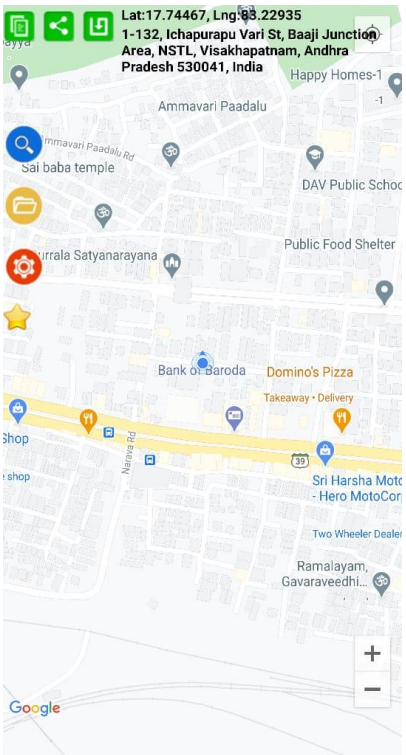

Fig-20 Speed limit testing at location-1

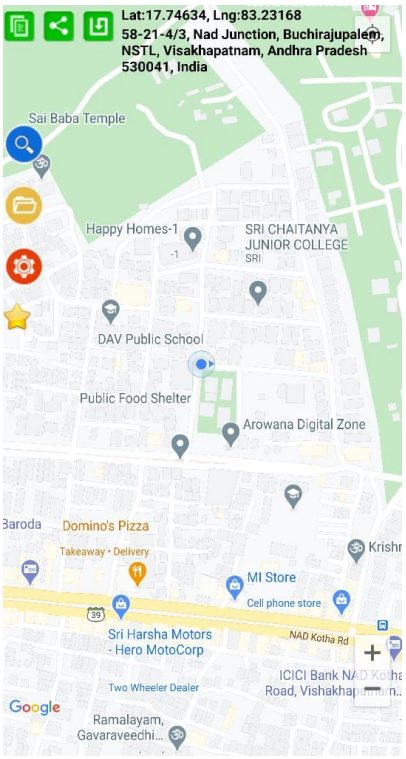

Fig-21 Speed limit testing at location-2

The speed limits for different areas are stored in the memory (Arduino) and at each instance, the GPS sensor receives the location and processes it into latitudes and longitude and is compared with the specified area coordinates and sends the speed limit to Master Arduino. The Master Arduino process information from the Hall Effect sensor and GPS module and controls the indicator. The speed limits for two different locations shown in the above figures are specified in the code.

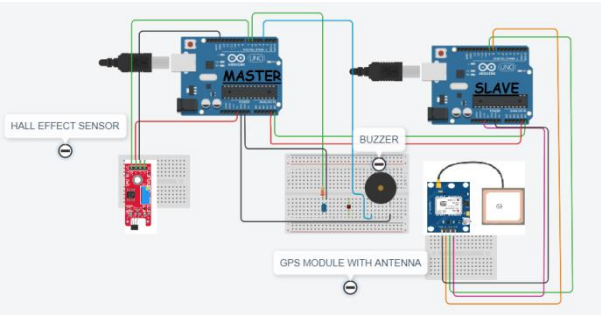

Fig-22 Circuit of Over Speeding Tracker

E. Testing model of Over Speeding Tracker

Fig-23 Sensor attached to the wheel

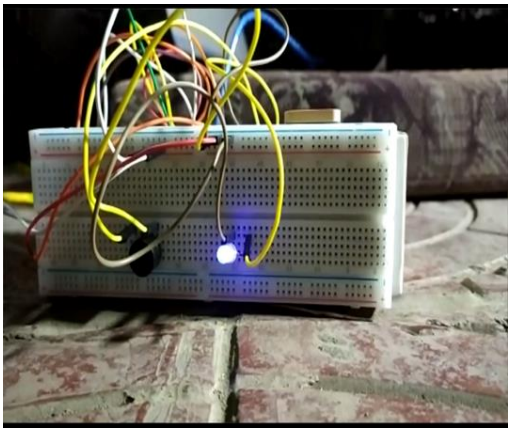

Fig-24 Indication on over-speeding

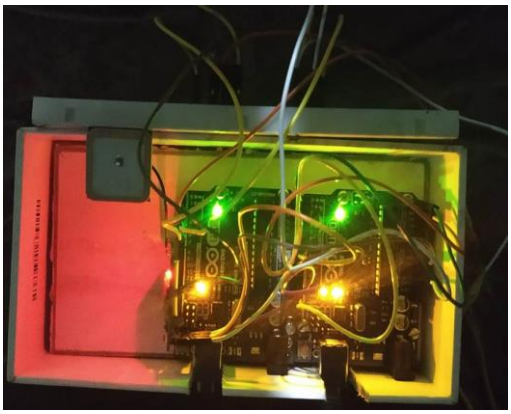

Fig-25 Over Speeding Tracker

V. CONCLUSION

This device mainly consists of three categories: - Speed detection; GPS tracking; Indicating (or) Alarming. Speed detecting devices work on the principle of Hall Effect using Hall Effect Sensor. This system offers speed estimation, location monitoring, alerting users if the speed limit is exceeded. It compares the speed of the vehicle at that instant to the speed limit that is predefined in the map. In contrast to conventional speedometers based on mechanical systems, the device uses state-of-the-art electronic equipment that allows a wide range of speed measurement with precision. The startup time of the GPS sensor is less and which enables to get the location coordinates accurately and instantly. Due to their high demagnetization resistance and

their high magnetic saturation levels, neodymium magnets are so solid that they can produce massive magnetic fields. As it features both an LED and a buzzer, even if one component fails to alert the user, the user gets alerted. Compared to existing speedometers, the device is easy to use and more economical; the lifetime of the device is also high. This device can also be modified with particular add-on's which focus on terrains and also the pothole tracker which helps to locate potholes and report them as well as indicating the accident-prone areas.

VI. REFERENCES

[1] Wang, Wen-cheng. "A Motor Speed Measurement System Based On Hall Sensor". Communications In Computer And Information Science, 2011, pp. 440-445. Springer Berlin Heidelberg, doi:10.1007/978-3-642-18129-0_69.

[2] Kumar, Abhimanyu et al. "Electronic Amplifier Based On Hall Effect Principle". Lecture Notes In Electrical Engineering, 2020, pp. 639-650. Springer Singapore, doi:10.1007/978-981-15-5089-8_63.

[3] Wing, M., Eklund, A. and Kellogg, L. (2005) "Consumer-Grade Global Positioning System (GPS) Accuracy and Reliability", Journal of Forestry, 103(4), pp. 169-173. doi: 10.1093/jof/103.4.169.

[4] Wang, Wen-cheng. "A Motor Speed Measurement System Based On Hall Sensor". Communications In Computer And Information Science, 2011, pp. 440-445. Springer Berlin Heidelberg, doi:10.1007/978-3-642-18129-0_69.

[5] Ying, G., 1999. Automobile overspeed warning system,Toronto: United States Patent. U.S. Patent No. 6,037,862

[6] Robert Gilhooley, 1979. VEHICLE SPEED ALARM. United States Patent.U.S. Patent No. 4,229,727

[7] Adil D., Srivastava N., Nitin K., Paulson, J. and Fong, T., 2010. Location tracking for mobile computing device. European Patent Office.

[8] KOMURA,, F., HIRAYAMA, Y., HOMMA, K. AND KAWASAKI, K.,NAVIGATION SYSTEM AND METHOD USING MAP DATA. 1st ed., United States Patent, 1994, pp. 13-26,

[9] Alison K, Brown, and Sturza Mark A. Vehicle Tracking System Employing Global Positioning System. Oliver, Peter Anthony BEACHCROFT STANLEYS 20 F, 1992, pp. 1-3,

[10] Linkohr, Jochen, and Korb DE. PROCESS FOR UPDATING MAP DATA AND NAVIGATION SYSTEMS. 1st ed., UNITED STATES PATENTS, 2005, pp. 5-7

[11] Iyer, R.Iyer, Rahul. "Arduino Serial Tutorial - Arduino Communication Protocols". Device Plus, 2016,

[12] Inventor William E Durie, Jr.John Gorham Andrew D FunkSydney Alamy Justin JacobyAmy Machacek SmithTroy StuartGary A Freeman Current accident, Road et al. "US10127810B2 - Vehicle Safety And Driver Condition Monitoring, And Geographic Information Based Road Safety Systems - Google Patents". Patents.Google.Com, 2012,

[13] Peter Mitchell"US8918243B2 - System And Method For Tracking And Alerting For Vehicle Speeds - Google Patents". Patents.Google.Com, 2011,