FINDING SPEED OF LINEARLY MOVING OBJECT USING LASER

J Component Project
for
PHY 1001 Engineering Physics

Submitted by

CHIRAYU KAPOOR (16BCE0775)

SAGAR UDAYAN (16BCE0790)

To

Dr. S. Balakrishnan

In

C2 SLOT

School of Advanced Sciences
VIT University, Vellore
Tamil Nadu - 632 014

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SCHOOL OF ADVANCED SCIENCES

J Component Project

ENGINEERING PHYSICS (PHY 1001)

It is certified that the project entitled "FINDING SPEED OF LINEARLY MOVING OBJECTS USING LASER" is the bonafide work for J component of Engineering Physics by the following students

CHIRAYU KAPOOR (16BCE0775)
SAGAR UDAYAN (16BCE0790)

of Computer Science Engineering branch under my supervision in C2+TC2 slot during the Fall Semester -2016 at V.I.T. University, Vellore-632 014.

INTRODUCTION

Our project is finding the speed of linearly moving objects using laser. Knowledge of Arduino, physical knowledge of circuiting as well as the in-depth knowledge of the working of the light dependent resistors was required for our project. The idea behind the project is that we are using two lasers to find the speed of the moving object.

The working of model is a follows:

We are doing this experiment for a fixed length. When the object passes through the first laser a timer is started which stops when the object will pass the second laser. This will provide us the time taken by the object to cover the distance. Now with the help of the available data we can easily find the velocity of the object using speed = distance/time.

All the calculations are being performed by the Arduino-Uno board which uses the written C# code to perform all the calculations.

This board is the soul of our project as the code written and uploaded in this board will start and stop the timer to provide us the time taken by the object.

This board is connected to other parts of the working model like resistors, LDRs using a breadboard and jump wires.

Connections of the Arduino ports to the breadboard plays a really important role in the project as these Arduino ports are configured in the programming. Lasers are also a major part of the project as they are used to send the signal to LDR. We are using pointer laser as they are easily available and easy to handle. Our project has lots of scope for practical application which involves speed guns which are used by police officers to bust the speedsters.

OBJECTIVE

- The aim of this project is to make a speedometer with the help of the lasers.

  Speedometer implies a device which can calculate the precise speed of an object irrespective of shape and size of object.

- Learning the concept of the lasers and LDR's-

  Our project helps us to understand the concept of laser. It describes us which type of laser will be good for this purpose (although we are using pointer laser) and being part of our syllabus it helped us for our exam too. We also got knowledge on the working of LDR's which was a new concept for us.

- This is going to give us a deep understanding of the laws of the motion and their use in regular life.

- Cost efficiency of our project was one of our major objectives which we think is fulfilled by the present model.

- Moral Values

This project gives the moral importance to work in team (team spirit).

DEFINITION OF THE PROBLEM

The basic problem is that we still today do not have a very cost efficient speed measuring device which could help in controlling accidents, mostly due to over speeding on roads. Therefore, we decided to build a device which can accurately calculate the speed of object using laser technology and having minimal cost. We just don't want to restrict this technology to the roads and highways but our target is to make it use in various defense structure too where accurate measurement of speed of moving objects is very important for satisfactory results. Thus we want our project to be such that we can implement it to a wider field. Though there are many devices like SSDR cameras which can do the same but they are very costly.

We thought of making a cost efficient fully automatic tech project which doesn't require human indulgence and is self-capable to the above state task.

We definitely have some limitations to our project till date. Our speed detection is limited to a one dimensional moving object only due to our limitation in knowledge about some of the concepts such as less knowledge about Arduino coding and multi-dimensional kinetics. This issue we think can be countered in near future after we are well versed with all the lagging topics.

Another major issue is its assembling and maintenance at a larger scale. This could have been solved if we had access to more sophisticated tools which would make our project more compact.

To reduce the alarming increase in the rate of road accidents due to lack of proper speed checks, which leads to massive loss in human life is one of our major objectives. This makes cheap, accurate and reliable tech more demanding in such a scenario.

Thus we can definitely achieve our vision after we resolve some of the above stated issues.

METHODOLOGY AND EXPERIMENT

In order to make a speedometer we need:

1. Bread Board
2. Arduino
3. 2 LDR's
4. Jumper wires
5. 2 10k ohm Resistors

Knowledge Required for this project:

- Using a breadboard for connections.
- Knowledge of Arduino coding and its working.
- We also must know theory related to working of LDR and Lasers.

  LDR stands for Light Dependent Resistor. Resistance of LDR decreases as intensity of light incident on it increases.

  LDR is used in clock radios, alarm devices (as the detector for a light beam), nightlights, outdoor clocks, solar street lamps, far-infrared detectors etc.
- We also need to determine the value of the current which flows through the LDR when laser is incident on LDR and when laser isn't present.

CIRCUIT EXPLANATION:

We connect the 2 LDRs 10 cm away on the breadboard and connect one terminal of the LDR with each other and then to the 5v power supply in the Arduino. The other terminal of the LDRs are connected in series with 10K ohm resistors and then grounded by connecting them to ground in Arduino. The grounded terminals are connected to analog ports of the Arduino (a0, a5). This is done to avoid flow of excess current in the analog ports.

After making the Arduino circuit we fix 2 lasers in front of the LDR so that the laser beam falls straight on the LDR. The basic idea here is we want to find the time taken for the moving object to cover the distance between the 2 lasers.

CODE LOGIC

We check that if the 1st LDR was triggered, if it was triggered, a timer starts and the initial value is noted. When the second LDR is tripped we again note the value of timer, subtract the values to find total time and hence calculate the speed.

In this we create our own function start calculation. This function checks when the 2nd LDR was triggered and does the necessary calculations to find the speed

and the prints it. The code also counts the number of objects that have passed and display object number along with their speed.

The triggering of LDRs are checked by seeing if the value of current falls beyond a specific value which is selected by knowing the value of current when laser is incident on the LDR and when there is no laser by trial and error done by us.

CODE

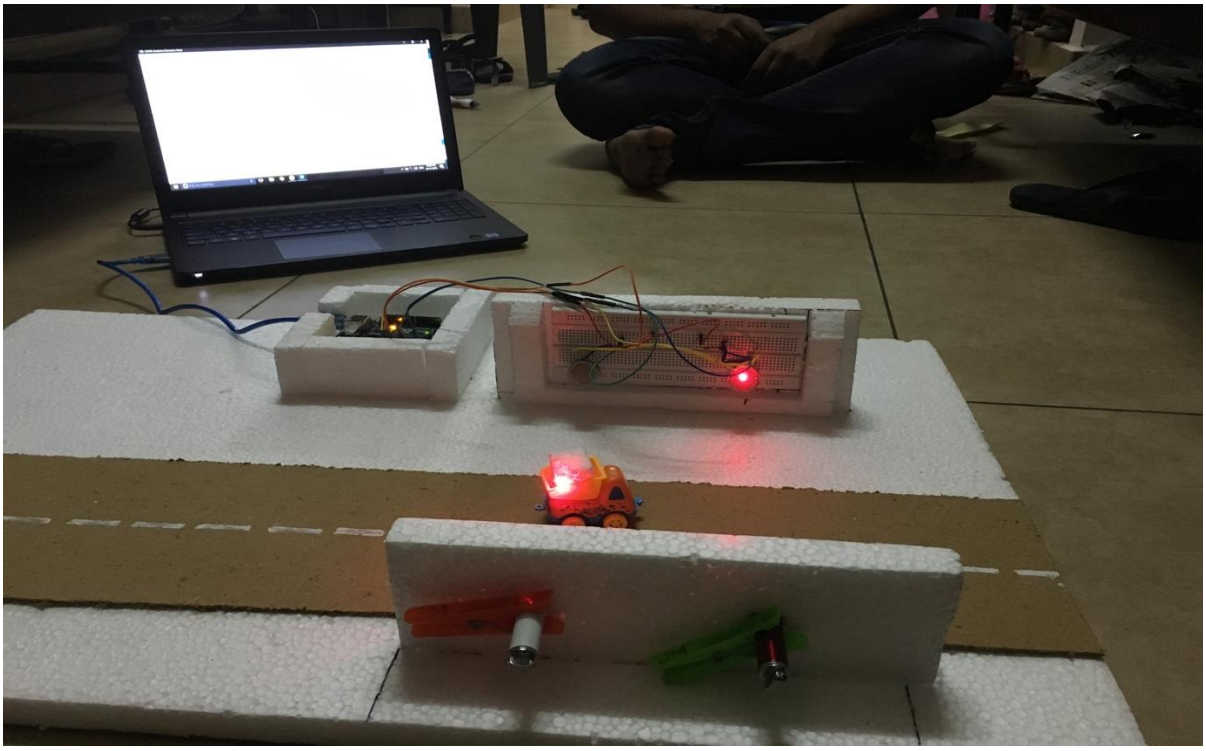
We have used C# language to code this project the code is as follows: -

```
unsigned long time1;
int photocellReading_1;
int photocellReading_2;
int threshold = 850;
float Speed;
float timing;
unsigned long int calcTimeout = 0;
void setup(void) {
 Serial.begin(9600);
}
void loop(void)
{
```

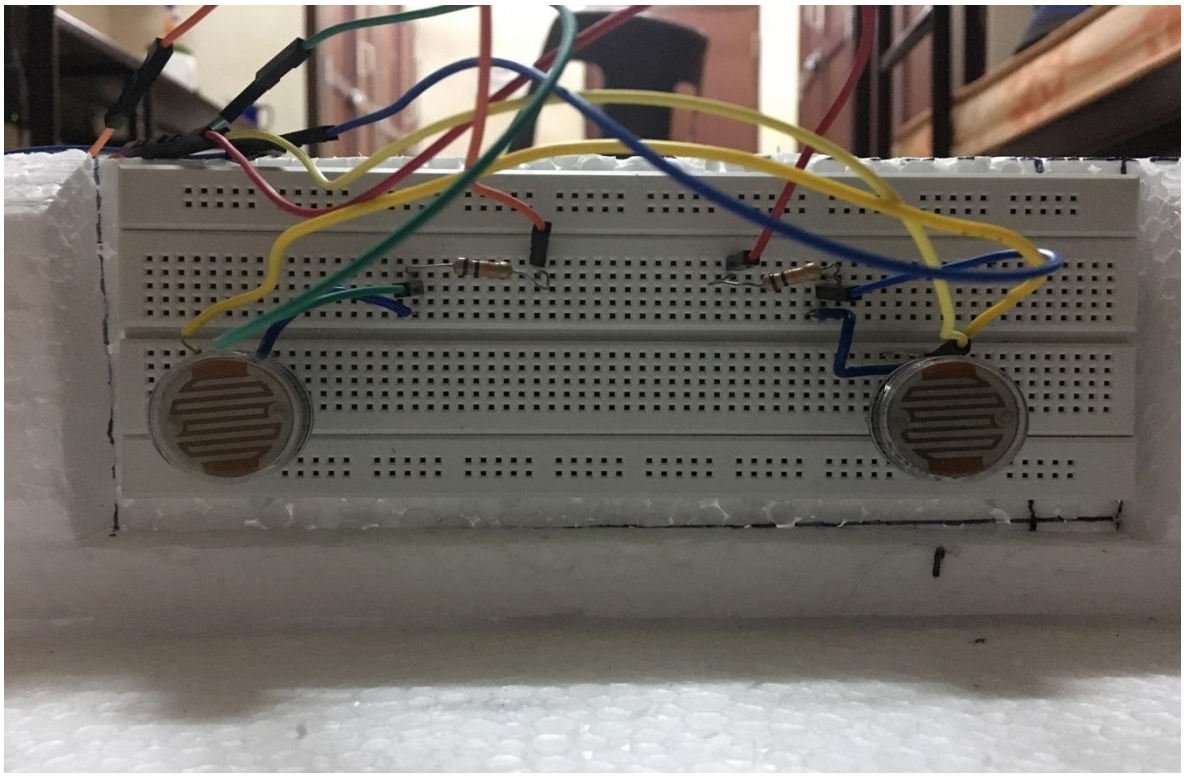
```
 photocellReading_1 = analogRead(0);
 photocellReading_2 = analogRead(5);
 if (photocellReading_1 < threshold)
 {
  time1 = millis();
  startCalculation();
 }
}
int i=0;
void startCalculation() {
 calcTimeout = millis();
 while (!(photocellReading_2 < threshold))
{
   photocellReading_2 = analogRead(5);
   if (millis() - calcTimeout > 50000) return;
 }
 timing = ((float) millis() - (float) time1) / 1000.0;
 if(timing>0)
 {
```

```
 i++;
 Speed = 0.1/timing;
 Serial.print("speed of object");
 Serial.print(i);
 Serial.print(":\n");
 Serial.print(Speed);
 Serial.print(" m/s\n");
 }
 delay(100);
}
```

SNAPSHOTS OF WORKING MODEL




UNO
ARDUINO



```
speed of object1:
0.03 m/s
speed of object2:
0.02 m/s
speed of object3:
0.04 m/s
speed of object4:
0.05 m/s
speed of object5:
0.04 m/s
speed of object6:
0.20 m/s
speed of object7:
0.06 m/s
speed of object8:
0.27 m/s
speed of object9:
0.18 m/s
```

APPLICATIONS OF OUR IDEA IN REAL LIFE

- To reduce overspeeding by measuring speed of vehicles on highways.

Laser technology has the benefit of being vehicle specific. The officer will maintain a fixed position off the road and will aim the device at a specific vehicle with the assistance of a viewfinder on the LDR device. It then measures the distance of the vehicle from the point of the device through laser technology and then by using simple mathematical formula or rate x time = distance, calculates the speed of the vehicle measured. The device will typically show two readings: the vehicle's speed and the distance measurement of the vehicle from the device.

- In wars to calculate the speed of missiles

  Army is using it calculate the missile speed during war and to take the take the necessary action to dough them.

- In aviation, speed measurement
- Laser Doppler velocity meter

Laser Doppler velocity meter (LDV), is the technique of using the Doppler shift in a laser beam to measure the velocity in transparent or semi-transparent fluid flows, or the linear or vibratory motion of opaque, reflecting, surfaces.

- Laser Range finder

  A laser range finder is a range finder which uses a laser beam to determine the distance to an object. The most common form of laser rangefinder operates on the time of flight principle by sending a laser pulse in a narrow beam towards the object and measuring the time taken by the pulse to be reflected off the target and returned to the sender.

- In guns with laser to detect the velocity of a person approaching or going away from a target and for proper aiming and shooting.
- In calculating speed of trains.
- Finding speed of animals for research purposes.

LIMITATIONS

- Accuracy may differ some times. Distance measurement pertaining to the accuracy of LDR may become compromised at greater distances. Like radar, LDR requires frequent checks to make sure it is functioning properly so as to avoid wrongful convictions. While it can be an accurate device, it is not without its flaws.

- Use of breadboard in the circuit: -

  Due to use of breadboard the circuit might get a little loose some time which gives a very significant error in the calculation.

- Hollow substance issues: -

  Hollow substance cannot be used as it may trip the laser multiple times leading to inaccurate speed measurements.

- Only linearly moving objects can be used.

- It doesn't calculate instantaneous speed of the object

  Our projects lacks in providing the instantaneous speed of the object passing through it but gives us an average speed of the object.

IMPROVEMENTS

- More accurate LDR's can be used but on the other hand it will increase the cost of the model.
- Using better quality laser for much more accurate result.
- Experimenting the model in real life scenario to get more accurate results.
- Making the device more compact.
- Using other versions of Arduino for faster processing
- Altering coding and checking threshold values for different places and situation to make the device more versatile and more accurate
- Decreasing the distance between two lasers to minimize the error
- Altering coding to process multiple objects at a time
- To run whole device including lasers and Arduino with a single battery.
- Using a single laser which will start the timer when the front of the object crosses the laser and stops when the whole object has passed i.e. the timer stays on till the object keeps the laser tripped.

SUMMARY

We have made an attempt to make a speed detector for linearly moving ground vehicles. It took us to do an extensive research on speed detection systems in modern day world , the technology used in it and the pros and cons. The presented model by group epsilon is a representation of our idea as to how speed detectors can be made to calculate an average speed of any object which moves linearly. As per our knowledge after a research on the internet and consulting Dr Balakrishna Subramaniam We made use of an Arduino to make the calculations by coding it as per our requirements and light dependents resistors to check the entry and the exit of the vehicles through a 10 cm separated laser sources. The readings obtained by our projected model are very close to accurate as per our experiments. Though the model have some flaws still the model can find many real life applications as stated above.

REFERENCES

- Guidance from our physics professor
- VIT library
- Internet
- Journals related to our project work
- Seniors

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Secondly we would also like to thank our parents and friends who helped us a lot in finalizing this project within the limited time frame.
We have given the very best of our abilities and have done a lot of hard work for the accomplishment of this project. Hope this will be well received by the teachers.
Thank you so much for your time.

THANK YOU!