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Analysis study on gear shifting levers in modern automobiles

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Abstract
This paper focus on the various types of gear shifting levers and its working analysis on a transmission system. In a manual gear box, the user has to engage the clutch and change the gears whereas in an automatic transmission system the mechatronic unit does the engaging and dis-engaging of the clutch, also changing the gears. With the help of the analyses, we can find out that how much effect does the lever do in helping in changing the gear form one place to another also the analyses also help us to understand how much Newton is used in changing the gears. Using lever mechanism expression practical analysis were done and found that first gear has to use 1.81kg or 17.75 newton and with the help of the lever it converts it to 299.53 newton and likewise for other gears analysis were found and concluded in this paper.

Keywords: Gear lever, manual gearbox, clutch, mechatronic newton, analyses, efforts to shift gear, gear shifter, vehicle transmission

Introduction
A transmission is also known as gear box it is a mechanical system in which there are group of gears or gear trains which convert the power form the engine to the wheels. The transmission helps the user to control the vehicles power output. Without the help of the transmission system the vehicle won't move. The gear lever is a vital component of a transmission system. It help in selecting the gears depending on the speed in manual example $1^{st}2^{nd}3^{rd}$ where as in automatic transmission it just helps in changing the drive direction example D(drive) R(reverse) N(neutral).There are 3 types of transmission system manual, automatic, automated manual.

Types of transmissions
Manual Transmission
In this kind of transmission system there can be single clutch or multi clutch system used. A clutch's function is to transmit rotational torque form a driving motor to the transmission. It is a simple disk which is pressed on to the flywheel. Now with the help of the clutch the driver is in control of shifting the gears up and down. Once the clutch is engaged it disconnects the engine form the transmission. Then the gears are shifted using a gear lever which is connected gear shift forks which is then connected to the gears. Once the gear is shifted it pushes the fork which then pushes the gear shift forks which in then engages the gear. Intermeshed gears are used in this type of transmission.

Automatic transmission
In this kind of transmission, the mechatronics is in controls the shifting of the gears. But automatic transmission there is no clutch, it uses a torque converter. A torque convers function is same as the function of a clutch but in this the transmission of power is done using fluid. As fluid is used to transmit power form the engine to the transmission there is a significant loss of power which is lost in the fluid. But the torque converter gives a smoother change of gears than a manual transmission. The automatic transmission uses epicyclic gears. For the gear ratio for higher speeds and lower speeds.

Automated manual transmission
In this kind of transmission ether one thing is automatic it is ether the clutch or the gears. These woks just like a manual transmission but with an automatic clutch which is hydraulic or working with strings.

Types of levers in transmission system

There is only one type of gear lever which is used in a manual transmission. The gear lever system consents of the gear lever gear shifting forks and gear hubs.

In automatic transmission there are three types. Standard, impulsion with Hall Effect, impulsion with optical sensers

Standard

In this type of gear lever, the user selects the from 4 options. PRND.

P (Parking)

In this option the transmission is locked and the engine is authorized to start. The shift lock is activated, to de-activate press the button or depress the break. The key lock function is also activated which means that the key can be removed.

R (Reverse)

In this option the transmissions reverse gear is engaged and the reverse lights also on.

N (Neutral)

In this option the transmission is on a dead point the engine can be started and stopped. The shift lock is on for going to reverse but then without the disengaging the shift lock it can go to drive.

D (Drive)

In this option the driver just needs to press the accelerator and the transmission will shift the gears automatically. The order of the gear shift will always be 1-2-3-4-5-6 while going up and while coming down it will be 6-5-4-3-2-1. The transmission will never skip a gear while going or coming back down.

L1, L2

The driver uses this option when they are in the hilly to get more torque in order to get better momentum to clime the hill. Once the car is put in 1 it sifts till first gear but when it is shifted in second the car will engage first and the second and stay till second.

L3, L4

The driver uses this option when they are in the city. As this has les torque in order the use less fuel in this the gear changes from 1 2 till 3 or 4 depending on the gear u choose 3 or 4.

Impulsion with hall shift

In this gear lever system it is same as the standard lever system but just beside the D (drive) there is "M+" and "M –, M+ is pushing up for increase in gear and M– is pulling down decrease in gear respectfully. There are 3 hall cells. Hall cell 1 is for "M-"Hall cell 2 is for ready to change and hall cell 3 is "M+" the working of this is, Theses hall cells are magnetic sensitive as there is a electro magnet under the lever whenever it comes near to any of the cell, the cell will send a signal to signal converter and that will send the single to the transmission to change the gear and visa verso for M.

Impulsion with Optical Senser

In this gear lever system in has the same functions as impulsion with hall shift but instead of the hall cells it is optical sensers which has a block in front of it that moves with the lever, besides the lever there is a light when the lever moves to a certain position the block moves away and the light falls on the senser and the senser sends the signal to the signal board. Depending upon the position of the lever the gear is shifted high or low

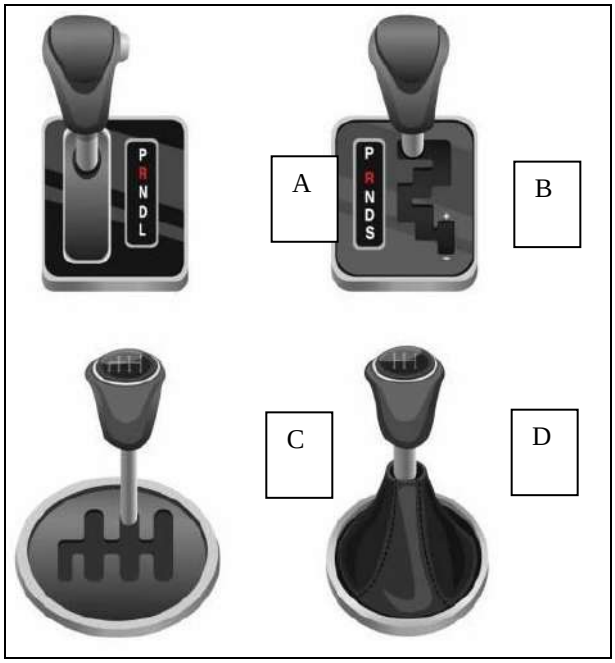

Fig 1:
A is a representation of automatic transmission car
B is a representation of manual automatic
C and D is a representation of a manual gear box

Analyses

To understand the lever mechanism with the help of 5 speed manual gear box. When the lever is shifted to first gear. The observation is done that the user has to move the lever to the left and then push it up to engage the gear. So, the lever is connected to a rod which then rotates and puts the leaf on the desired shift link for first and second gear. Once the user pushes the lever in to first gear it pulls the rod which then pulls the lead and then pulls the shift link. The gear is engaged with the help of the shift lock which is connected to the gear link. When we shift the up and down we use different force to pull and push the gear lever.

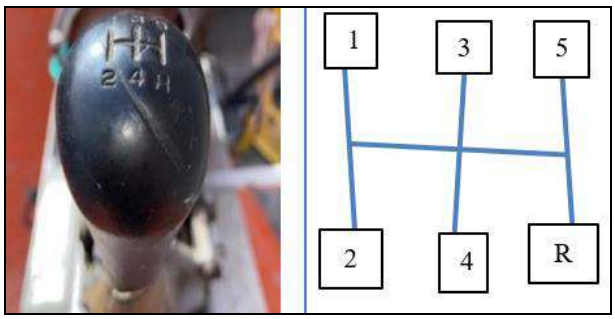

Fig 2: This is a diagram of a manual gear lever.

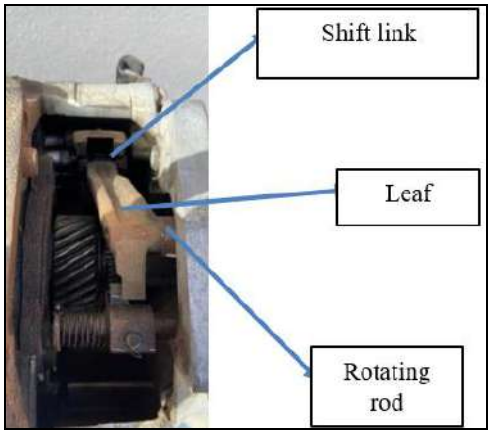

Fig 3: This is a diagram of a rotating rod leaf and shift link.

Fig 4: This is a picture of how much force is used to push the lever up 2.49 kgs.

Fig 5: This is a picture of how much force is used to pull the lever down 1.81 Kgs.

Fig 6: First Gear

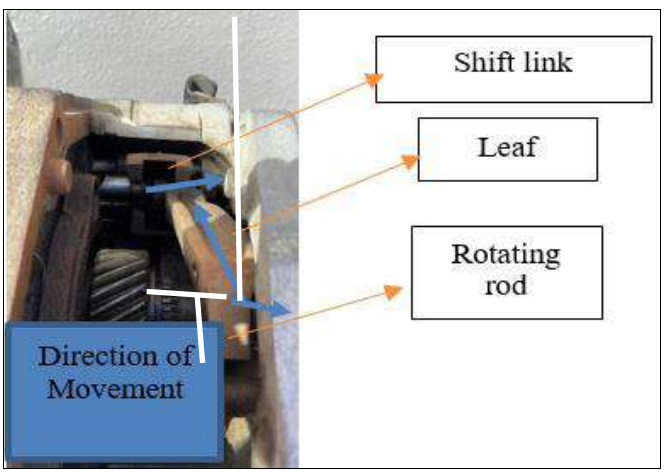

Fig 6: This is a diegram of how the fisrt gear is getting engaged from the lever.

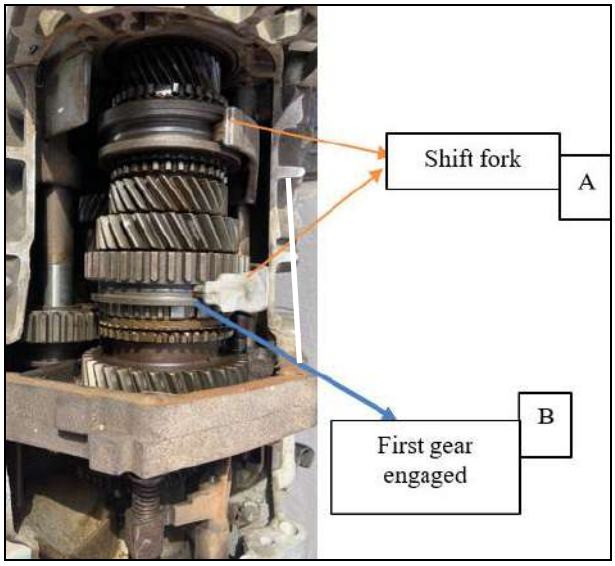

Fig 7: This is a diagram of what happens in the shift fork when the gear is shifted to first gear.

First gear working x`

F1 * a = F2 * b
F1 = 1.81 kg 1kg = 9.81 newton = 1.81*9.81=17.75
a = 45 cm
b = 5 cm
f2 =?
F1/f2 = b/a
17.75/f2 = 5/45
17.75*45/5= f2
798.75/5= f2
159.75= f2
F3=159.75
c=22.5 cm
b=12 cm
f4=?
159.75/f4 = 12/22.5
159.75*22.5=f4*12
3594.37/12= f4
299.53 = f4

This calculation proves that the user has to use 1.81kg or 17.75 newton and with the help of the lever it converts it to 299.53 newton.

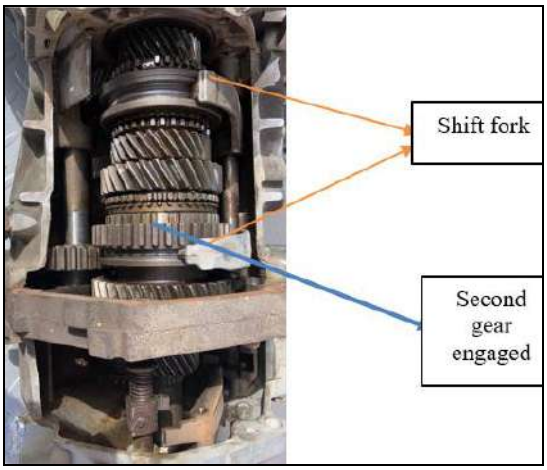

Fig 8: Second gear

This is a diagram of what happens in the shift fork when the gear is gear is shifted to second. To understand the lever mechanism of the second gear. The observation is done that the user has to move the lever to the left and then pull it down to engage the gear. So, the lever is connected to a rod which then rotates and puts the leaf on the desired shift link for first and second gear. Once the user pulls the lever in to the second gear it pushes the rod which then pushes the leaf and then pushes the shift link. The gear is engaged with the help of the shift lock which is connected to the gear link.

Working of second gear

F1 * a = F2 * b
F1 = 2.49 kg 1kg = 9.81 newton = 2.49*9.81=24.42
a = 45 cm
b = 5 cm
f2 =?
F1/f2 = b/a
24.42/f2 = 5/45
24.42*45/5= f2
1098.9/5= f2
219.78= f2
F3=219.78
c=22.5 cm
b=12 cm
f4=?
219.78/f4 = 12/22.5
159.75*22.5=f4*12
4945.05/12= f4
412.08 = f4

This calculation proves that the user has to use 2.49kg or 24.42 newton and with the help of the lever it converts it to 412.08 newton.

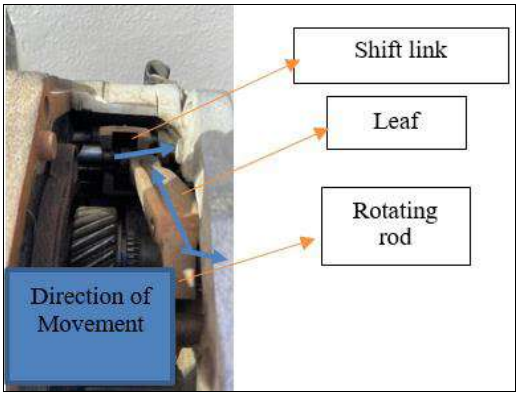

Fig 9: Third gear

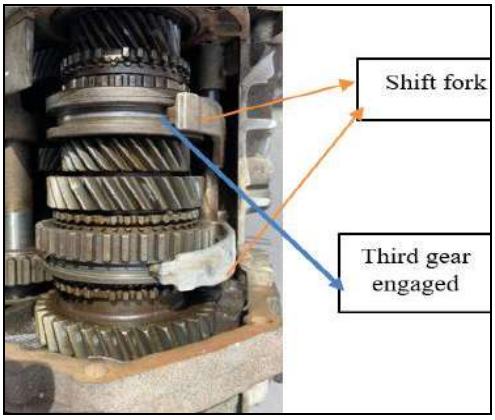

Fig 10: This is a diagram of how the third gear is getting engaged from the lever.

This is a diagram of what happens in the shift fork when the gear is shifted to third gear. To understand the lever

mechanism of the third gear. When the lever is shifted to third. The observation is done that the user has to move the lever to the middle and then push it up to engage the gear. So, the lever is connected to a rod which then rotates and puts the leaf on the desired shift link for third and fourth gear. Once the user pushes the lever in to third gear it pulls the rod which then pulls the leaf and then pulls the shift link. The gear is engaged with the help of the shift lock which is connected to the gear link.

Working of third gear

F1 * a = F2 * b
F1 = 1.81 kg 1kg = 9.81 newton = 1.81*9.81=17.75
a = 45 cm
b = 5 cm
f2 =?
F1/f2 = b/a
17.75/f2 = 5/45
17.75*45/5= f2
798.75/5= f2
159.75= f2
F3=159.75
c=22.5 cm
b=20 cm
f4=?
159.75/f4 = 20/22.5
159.75*22.5=f4*20
3594.37/20= f4
179.71 = f4

This calculation proves that the user has to use 1.81kg or 17.75 newton and with the help of the lever it converts it to 179.71 newton.

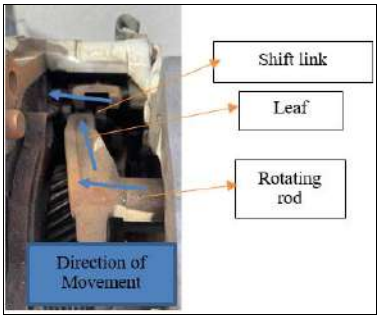

Fig 11: Fourth gear

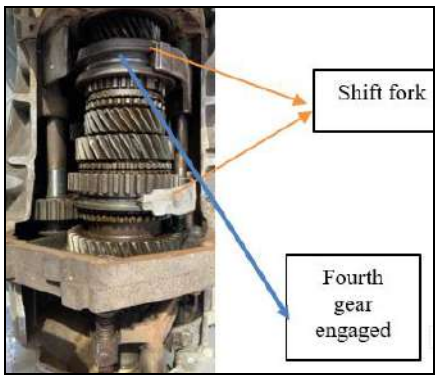

Fig 12: This is a diagram of how the fourth gear is getting engaged from the lever.

This is a diagram of what happens in the shift fork when the gear is shifted to fourth gear

To understand the lever mechanism of the fourth gear. The observation is done that the user has to move the lever to the middle and then pull it down to engage the gear. So, the lever is connected to a rod which then rotates and puts the leaf on the desired shift link for third and fourth gear. Once the user pulls the lever in to the fourth gear it pushes the rod which then pushes the leaf and then pushes the shift link. The gear is engaged with the help of the shift lock which is connected to the gear link.

Working of forth gear

F1 * a = F2 * b
F1 = 2.49 kg 1kg = 9.81 newton = 2.49*9.81=24.42
a = 45 cm
b = 5 cm
f2 = ?
F1/f2 = b/a
24.42/f2 = 5/45
24.42*45/5= f2
1098.9/5= f2
219.78= f2
F3=219.78
c=22.5 cm
b=20 cm
f4=?
219.78/f4 = 20/22.5
159.75*22.5=f4*20
4945.05/20= f4
247.25 = f4

This calculation proves that the user has to use 2.49kg or 24.42 newton and with the help of the lever it converts it to 247.25 newton.

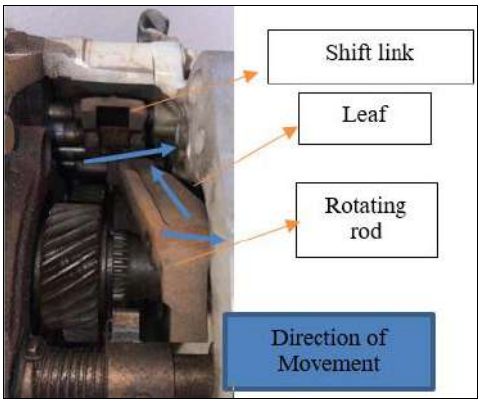

Fig 13: Fifth gear

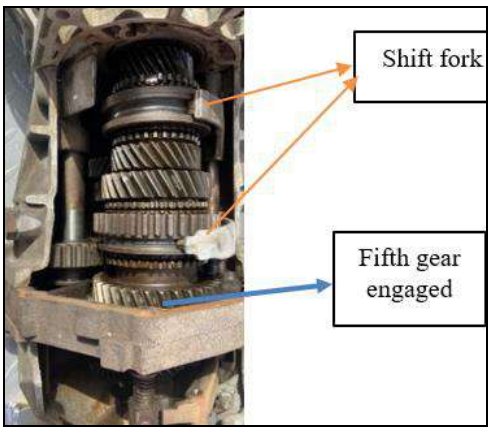

Fig 14: This is a diagram of how the fifth gear is getting engaged from the lever.

This is a diagram of what happens in the shift fork when the gear is shifted to fifth gear

To understand the lever mechanism of the fifth gear. When the lever is shifted to fifth. The observation is done that the user has to move the lever to the right and then push it up to engage the gear. So, the lever is connected to a rod which then rotates and puts the leaf on the desired shift link for fifth and reverse gear. Once the user pushes the lever in to fifth gear it pulls the rod which then pulls the leaf and then pulls the shift link. The gear is engaged with the help of the shift lock which is connected to the gear link.

Working of fifth gear

F1 * a = F2 * b
F1 = 1.81 kg 1kg = 9.81 newton = 1.81*9.81=17.75
a = 45 cm
b = 5 cm
f2 =?
F1/f2 = b/a
17.75/f2 = 5/45
17.75*45/5= f2
798.75/5= f2
159.75= f2
F3=159.75
c=22.5 cm
b=16 cm
f4=?
159.75/f4 = 16/22.5
159.75*22.5=f4*16
3594.37/16= f4
224.64 = f4

This calculation proves that the user has to use 1.81kg or 17.75 newton and with the help of the lever it converts it to 224.64 newton.

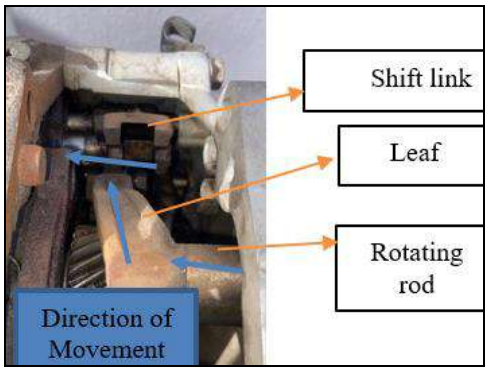

Fig 15: Reverse gear

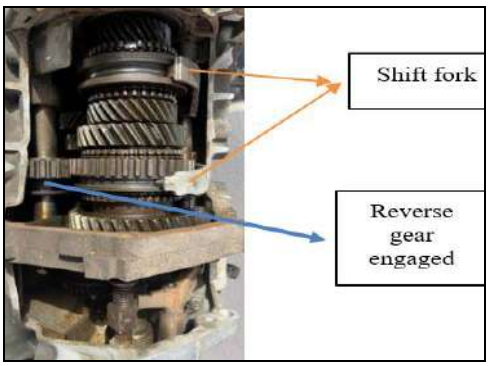

Fig 16: This is a diagram of how the reverse gear is getting engaged from the lever.

This is a diagram of what happens in the shift fork when the gear is shifted to reverse gear

To understand the lever mechanism of the reverse gear. The observation is done that the user has to move the lever to the right and then pull it down to engage the gear. So, the lever is connected to a rod which then rotates and puts the leaf on the desired shift link for fifth and reverse gear. Once the user pulls the lever in to the reverse it pushes the rod which then pushes the leaf and then pushes the idle gear. The idle gear is also connected to the shift link which help engage the motion in reverse

Working of reverse gear

F1 * a = F2 * b
F1 = 2.49 kg 1kg = 9.81 newton = 2.49*9.81=24.42
a = 45 cm
b = 5 cm
f2 =?
F1/f2 = b/a
24.42/f2 = 5/45
24.42*45/5= f2
1098.9/5= f2
219.78= f2
F3=219.78
c=22.5 cm
b=16 cm
f4=?
219.78/f4 = 16/22.5
159.75*22.5=f4*16
4945.05/16= f4
309.06 = f4

This calculation proves that the user has to use 2.49kg or 24.42 newton and with the help of the lever it converts it to 309.06 newton.

Result

Based on these results we can understand how the lever works and what are the forces used on the lever to engage the gear. For the first gear the user has to use 1.81kg or 17.75 newton and with the help of the lever it converts it to 299.53 newton.

For the second gear the user has to use 2.49kg or 24.42 newton and with the help of the lever it converts it to 412.08 newton.

For the third gear the user has to use 1.81kg or 17.75 newton and with the help of the lever it converts it to 179.71 newton.

For the fourth gear the user has to use 2.49kg or 24.42 newton and with the help of the lever it converts it to 247.25 newton.

For the fifth gear the user has to use 1.81kg or 17.75 newton and with the help of the lever it converts it to 224.64 newton.

For the reverse gear the user has to use 2.49kg or 24.42 newton and with the help of the lever it converts it to 309.06 newton.

Based on this analyses it is understood that how automatic is so much more better that manual as the user has nothing much to do other than putting it in drive where as it is proven that the gear lever uses needs more energy form the user that is driving the car

Reference

1. This journal is with reference of the professor in Asti academy Mr. Mohammad Sameer Baig lectures and notes that have been made. GM Automatic Overdrive

Transmission Builder's and Swapper's Guide
2. ATSG JATCO JF011E CVT Automatic Transmission Repair Manual (F4A51, CVT2, RE0F10A Transmission BEST STEP BY STEP Repair Book Available)
3. Tribology and Dynamics of Engine and Powertrain: Fundamentals, Applications and Future Trends
4. ZF TRANSMATIC Transmission Gearbox Workshop Repair Manual
5. FORD 6R80 Automatic Gearbox Workshop Service Repair Manual
6. F4A4 Automatic Transmission REBUILD Manual
7. Motor Vehicle Mechanic's Textbook By F. K. Sully

Appendix

1] 1kg = 9.81 Newton

2] 1N=kg *m/s^2

Where N is the force in Newton.

Kg is the mass in kilogram.

M is the distance traveled in meter.

S is the time duration in seconds