

A Statistical Data Analysis of Road Accidents and Traffic Volume in Jaipur

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Abstract-Rapid development of traffic infrastructure in urban areas is resulting into increase in travel demand and private vehicle ownership, in the present scenario the existing infrastructure has fails to match the demand that lead to traffic congestion, vehicular pollution and accident. The increasing of traffic volume at our intersection has been arise a problems like road accidents, conflicts and congestions. These problems can be solved by providing an efficient traffic signal control at the intersection for continuous and efficient movement of vehicles through the intersection. According to traffic signal, signal timing is most important which is used to decide green time of the traffic light shall be provided at an intersection and how long the pedestrian walk signal should be provided. Traffic volume studies are to be made to determine the number, movement and classification of vehicles at the given location. These data is used identify normal flow of the road, determine the influence of heavy vehicles or pedestrians on vehicular traffic volume. The length of the sampling period depends on the type of count being taken. According to manual count could be used to obtain the traffic volume data. The collected data is converted into PCU units. Webster's method is a rational approach for signal design. The design is simple and is totally based on formula's laid down by Webster.

Keywords- Traffic volume, Road accidents.

I. INTRODUCTION

The process of rapid and unplanned urbanization has resulted in an unprecedented revolution in the growth of motor vehicles world-wide. The alarming increase in morbidity and mortality owing to road traffic incidents (RTI) over the past few decades is a matter of great concern globally [1]. At present motor vehicle accidents

rank ninth in order of disease burden and are projected to be ranked third in the year 2020. India accounts for more than 200,000 deaths because of road accidents, according to the Global Road Safety Report, 2015 released on Monday by the World Health Organization (WHO). This is 46% more than the national statistics released by the National Crime Records Bureau (NCRB) in July. Jaipur, a 290-year-old city is the state capital of Rajasthan. It lies on the Aravalli hills, 431 meters (1414ft) above sea level, over an area of 484.64 sq.km. Jaipur is now a Metropolitan area, is the tenth major city in India, with a population of above 3 million. Unlike other Indian metros it continues to attract considerable migrant population due to its strategic geographical location, multilingual and cosmopolitan culture, tremendous growth potential and investment. The existing road network in the city is inadequate. Functionally the road does not have any hierarchy as every individual road changes its characteristics after a short distance. At present 5.84% of the total developed area is belong to roads which is much below the desired level. Moreover, the vehicular population growth is quite high with just registered motor vehicles in 4.2million to 12.4 million vehicles on 31, march2015, an increase of around 3-fold in span of 10 years. Most of roads in Jaipur city are heavily encroached by parked vehicle, hawker and by the person of road side business. This thing result not only increases in the traffic volume but also in the traffic accident and make our life at risk. This paper was an attempt to analyze the road accidents in Jaipur using annual data from 2005 to 2015.

II. DATA COLLECTION

Requirements Data of road accidents were collected in two steps. [2] In the initial stage, data on road accidents of Jaipur city were collected from three Police Stations (East zone police station near Gandhi circle, West zone police station Bani Park, South zone police station Ajmeri gate) in the city for three years. The data included Accident Date, Accident Time, Location of the Accident, Collision Type, Number of Vehicles Involved, Number of Deaths, Injury, Cost of Property Damage, Details of Driver and some more information about how accident occurred. It was found that more than thousand accidents occurred in Jaipur in last year. After analyzing the accident data, the road intersection and mid-block having maximum frequency of accident is identified. Also, for determine the present status of accident and traffic pattern we are taking data by self-examining at the places. Traffic police, Jaipur, categorized accident hotspot in four different zones and each zone covers major accident-prone area of Jaipur. Each zone consists of minimum of six accident prone areas.

Four major zones are- • South Zone • East Zone • West Zone • North Zone

SOUTH ZONE

1	200 Feet Bypass Circle.
2	Badarwas Tiraha Gopalpura Road.
3	Dwarkadas Park Circle.
4	Government Hostle Circle.
5	Jrotri Nagar Thana Moad Sahkar Marg.
6	Dhuleshwer Garden Circle.

EAST ZONE

1	B-2 Bypass Circle
2	Goushala Tonk Road
3	Front Road of India gate Tonk Road
4	In Front of Saras Parlour
5	Trimurti Circle
6	In Front of M.N.I.T Gate
7	Bajaj Nagar

WEST ZONE

1	Panupetch Tiraha
2	Dahar Ka Balaji
3	Khetan Circle
4	Alka Tiraha
5	Road No. 14 Sikar Road
6	Jodla Power House
7	In Front of Hyper City Jhotwarw Pulia
8	Kanta Choraha
9	Road No. 5 Cut Express Highway
10	Dhabas Pulia Express Highway
11	Gandhi Path Queen's Road

NORTH ZONE

1	Road Towards Nahargarh and Jaigarh
2	ICICI Bank Circle Vidhyadhar Nagar
3	In Front of Vidhyadhar Nagar Stadium
4	Galta Gate Circle
5	Meena Petrol Pump Cut Dehli Road
6	RAC Cut Dehli Road
7	Idgah Pada Mandi Dehli Road
8	Dhobi Ghat
9	Ram Garh Moad
10	Bandh ki Ghatj
11	Kanak Ghatj
12	Mambagh
13	Sarva Moad

Black Spots in the State of Rajasthan

S. No.	Name of the District	Jurisdiction/ Police Station	Location of accidents including chainage (km to km)	NH No.	No. of fatalities during 2011	Reasons for frequent accidents	Nature of treatment required at the spot/stretches
1	Vishwakarma Jaipur West		Road No. 1, 5, 6, 9, 12, 14 Vishwakarma Area	11	15	BRTS cut, heavy traffic, over speeding and careless driving.	construct Pedestrian footpath on every cut of BRTS and to create awareness about traffic rules
2	Chomu Jaipur West		Jaitpura	11	3	Industrial area and no speed limit.	Fix speed limit, install signage, construct speed breakers and provide parking lights.
3	Bagru Jaipur West		Thikriya More	8	5	New construction of Vatika city and movement of Labourers and movement of heavy vehicles through Thikaria village to avoid toll tax.	provide traffic lights
4	Bagru Jaipur West		Bhakrota	8	9	Heavily Populated area and traffic movement at crossing.	need of bridge
5	T.P. Nagar Jaipur East		Ghat ki Guni Agra Road	11	4	Roads are steeply sloped and curved and there are no street lights.	provide street lights, install caution boards and speed breakers in accident prone areas
6	Kanauta Jaipur East		Mali ki Kothi Bagrana	11	9	Damage of railing near Highway and no railing in some area and densely populated area on both sides of the road. Main reason is stopping of heavy vehicles on main Highway.	Repair of Damage railing behind Highway and construct railing in some area where it is necessary . It is good to construct bridge on densely populated area on both sides of the road.
7	Bajaj Nagar Jaipur East		Tonk Pulia and nearby	12	1		
8	Chaksu Jaipur South		Chaksu	12	41	Heavy traffic	Need for Four lanes on State Highways
9	Shivdaspura Jaipur South		Shivdaspura	12	19	Construction of four lane in progress.	Completion of construction work will mitigate the problem.
10	Shyamnagar Jaipur South		Shalimar Bagh to Ajmer road crossing	8	6	Heavy traffic and cuts at many places in the divider of road.	Widening of road and closure of unnecessary cuts on road divider.
11	Shahapura Jaipur Rural		Bhabhru	8	13	Cuts on NHW, crossing points and curved roads	Close cuts on NHW and install caution boards on crossing and turning points. To coordinate with NHAI to improve accident prone areas.

Places of Accident Analysis:

1. ChomuPulia Circle
2. RidhiSidhiChoraha
3. B2 Bye Pass
- 4.Haldi Ghati

III. OBJECTIVES

The purposes of the study include:

1. To design road signals for road users.
2. To minimize accidents on the road and directing the government for road problem in Jaipur city.
3. Educating about road signals for road users and discipline rule on the road in Jaipur city.
4. Providing roadside mobile clinics for treatment of accident victims free of charge.
5. To analyses the danger variables and clumsy locales (Hot spots) in Jaipur city.
6. For assessment the nature and class of Accident.

7. To help the proposed plan and give monetary legitimization to the improvement recommended by the traffic engineer

IV. ACCIDENT ANALYSIS

It is the exertion decides why the accidents happened from the information accessible and the examination of accidents remaking considers. One of the fundamental extents of traffic on road system is the volume of traffic using the road in a given time frame when the traffic is made out of different kinds of vehicles [3]; it is the standard practice to change over the stream into tantamount P.C.U by using certain equivalency factor. The stream is conveyed as PCU every hour. Strategies For Road Traffic Flow Counting

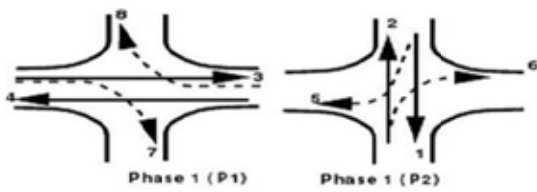
1. Manual method
2. Combination of manual & mechanical method
3. Automatic method
4. Moving observer method

5. Photographic method

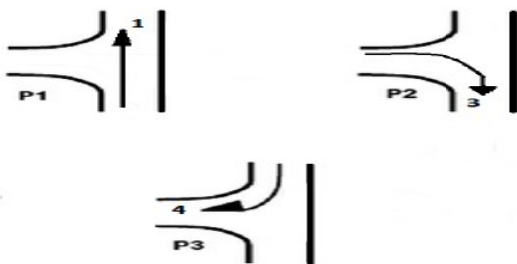
We Can Provide Elevated Road from Ridhi Sidhi to Agarwal Form House Road and Also Provided Foot Over Bridge to Cross Road by Student from Near Shankar Bhojnalya (triveni) To Near Akash Coaching (triveni circle). We can provide underpass road from B2 bypass to mansarover. We can provide clover leaf road from Jawahar circle to gopalpura road.

V. METHODOLOGY

Two phase system-[4] it is usually adopted if through traffic is significant compared to the turning movements. Non-conflicting through traffic 3 and 4 are grouped in a single phase and non-conflicting through traffic 1 and 2 are grouped in the second phase. However, in the first phase flow 7 and 8 over some conflicts and are called permitted right turns.



Three phase signals-this is adopted for a three-legged intersection, where there are two conflicting movements which are right turns for both the roads and two non-conflicting movements which are through movements. The phase plan for this kind of signals is shown in the following figure. From fig., phase 1 (p1) is provided by only allowing the non-conflicting traffic 1, phase 2 (p2) and phase 3 (p3) are provided by allowing the conflicting traffic 3 and 4 respectively.



Cycle Time -Cycle time is the time taken by a signal to complete one full cycle of iterations, i.e., one complete rotation through all signal indications.[5] It is denoted by C. In Webster Method corresponding to least total delay to the vehicles at signalized intersection has been worked out. This is rational approach. The field work consists of finding (i) Saturation flow S per unit time on each approach of the intersection and (ii) the normal flow "q" on each approach during the design approach. The standard values for saturation flow S according to Webster are given as in the below table.

Width in m	3.0	3.5	4.0	4.5	5.0	5.5
PCU/hr	1850	1890	1950	2250	2250	2900

Saturation flow for widths 3 to 5.5 meters

Based on the higher value of normal flow, the ratio

$$Y_1 = \frac{q_1}{s_1} \text{ and } Y_2 = \frac{q_2}{s_2} \dots\dots\dots (1)$$

Determined on the approach roads 1 and 2. In the case of mixed traffic, it is necessary to convert all the values in terms of PCU values which should be determined separately. The Saturation flow is to be obtained from careful field studies by noting the number of vehicles in the stream of compact flow during the green phases and the corresponding time intervals precisely. In the absence of the data approximately value of saturation flow is estimated assuming 160 PCU per 0.3-meter width of the approach. The normal flow of the traffic is also determined on the approach roads from the field studies from the design period (during the peak or off-peak hours, as the case may be.)

The optimum signal cycle given by

$$C_0 = (1.5L + 5) / (1 - y) \dots\dots\dots (2)$$

Where L = total lost time per seconds

$$L = (2n + R) \dots\dots\dots (3)$$

n = number of phases

R = All red time

$$Y = Y_1 + Y_2 + Y_3 \dots\dots\dots (4)$$

Then

$G1=Y1(C0-L)$ and

$G2=Y2(C0-L)$ (5)

Similarly, process is followed when there are more number of signals phase.

Formulas used in this work are:

1. Accident rate per kilometer $R = (A/L)$

R = Total accident rate per km for one year

A = Total number of accidents occurring in one year

L = Length of control section in kms

2. Accident rate based on population

$R = (B * 100000) / P$ [6]

R = Death rate per 100,000 population

B = Population of area

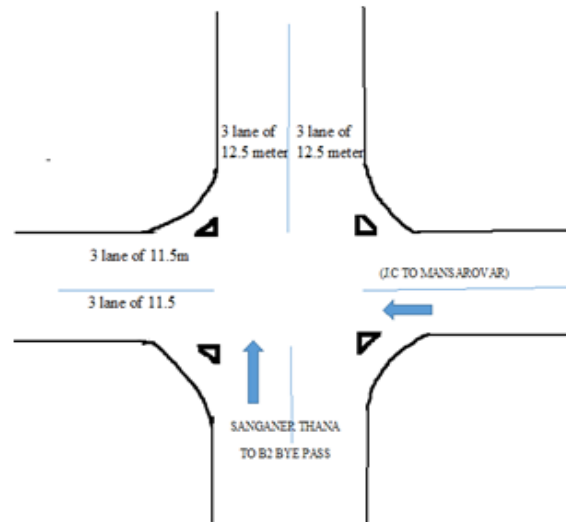
P = Total number of traffic death in one year

B2 Bypass Hotspot

As the diagram shows the traffic flow condition on the B2 bypass, so mainly the accidents are happening on the B2 bypass occur in night time due to the rush driving of trucks. Also, the reason behind the accidents is that the road to Man-Sarovar is having the divider but there is no obstruction so the glazing of the vehicle headlight is falling on the opposite side person and leads to an accident. So, for decreasing the rate of accident here we have to apply proper arrangement [7] in the dividends and also there are provocations of cameras so anyone who does not follow the rule should be punished. There should be speed breakers so that the speed leads down and make a decrement in the accident rate.

Accident Rate per-km on B2 Bypass

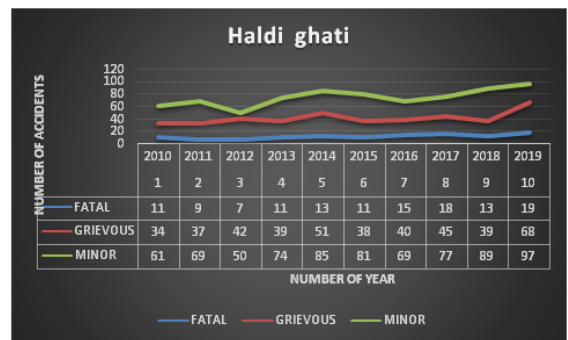
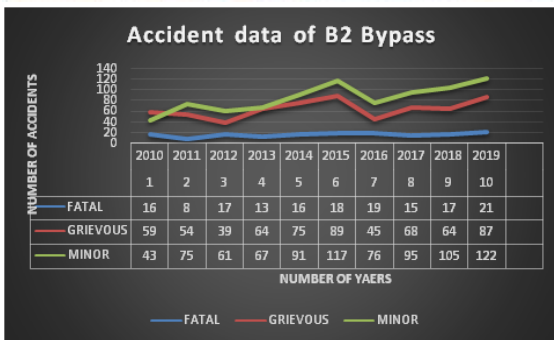
S.no	year	accident	width	Accident per km
1	2010	118	5	23.6
2	2011	137	5	27.4
3	2012	117	5	23.5
4	2013	144	5	28.8
5	2014	182	5	36.4
6	2015	124	5	24.8
7	2016	140	5	28
8	2017	178	5	35.5
9	2018	186	5	37.5
10	2019	230	5	46



S.No.	YEAR	FATAL	GRIEVOUS	MINOR
1	2010	16	59	43
2	2011	08	54	75
3	2012	17	39	61
4	2013	13	64	67
5	2014	16	75	91
6	2015	18	89	117
7	2016	19	45	76
8	2017	15	68	95
9	2018	17	64	105
10	2019	21	87	122



Data of accident of Haldi Ghati -				
S.NO.	YEAR	FATAL	GRIEVOUS	MINOR
1	2010	11	34	61
2	2011	9	37	69
3	2012	7	42	50
4	2013	11	39	74
5	2014	13	51	85
6	2015	11	38	81
7	2016	15	40	69
8	2017	18	45	77
9	2018	13	39	89
10	2019	19	68	97



Haldi-Ghati Marg: As we understand that here there is on one side a 3 way while on another side there is a 2-way road so as many times there is people lean toward the substitute way so they are pick the assistance way so they will move out fatly and in view of which people come from the straight 3 way they will get crushed by each other and it will prompt accident. Here, the standard reason for the setback is relied upon to the distant of any traffic police so they get viably cross the light and not notice the traffic rule, so here we need to give camera additionally.

Chomu-Pulia Choraha-The main reason behind the accident is the low space available for the vehicle for merging and diverging so here, we do some changes in the existing design.



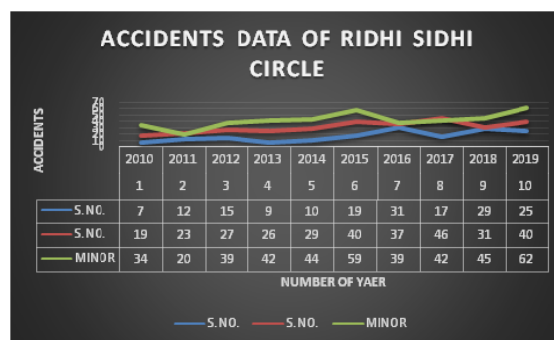
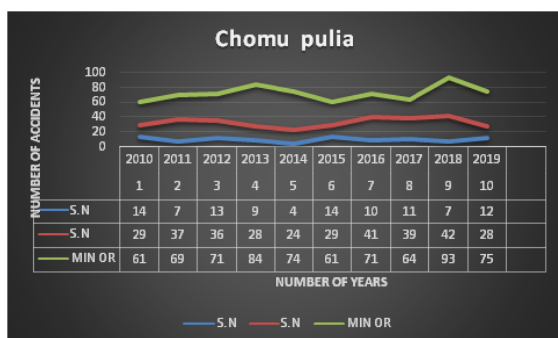
So, as we see in the figure that there is a central circle so it is having a diameter of 36.27meter so the vehicle that are crossing here are having a difficulty while there is increase in the traffic volume so here, we are decreasing down the diameter of the circle so the width near the circle got increase the nearby road width also the merging and diverging radius got increases so that the vehicles are easily merges and diverges. The width of the nearby road of the circle are change to 11.10meter and 9.8 meter towards Jaipur Road of 7.6meter and 6.1 meter towards sikar road respectively.

Accident Rate Per Km on Chomu Pulia

CHOMUPULIA				
S.NO	YEAR	TOTAL ACCIDENT	WIDTH OF ROAD	ACCIDENT RATE PER KM
1	2010	104	5.5	18.90
2	2011	113	5.5	20.54
3	2012	120	5.5	21.81
4	2013	121	5.5	22
5	2014	102	5.5	18.54
6	2015	104	5.5	18.9
7	2016	122	5.5	22.18
8	2017	114	5.5	20.72
9	2018	142	5.5	25.81
10	2019	115	5.5	20.90

Accident Data of chomu- pulia				
S.No.	Year	Fatal	Grievous	Minor
1	2010	14	29	61
2	2011	7	37	69
3	2012	13	36	71
4	2013	9	28	84
5	2014	4	24	74
6	2015	14	29	61
7	2016	10	41	71
8	2017	11	39	64
9	2018	7	42	93
10	2019	12	28	75

Accident Data of Ridhi Sidhi Circle				
S.No	Year	Fatal	Grievous	Minor
1	2010	7	19	34
2	2011	12	23	20
3	2012	15	27	39
4	2013	9	26	42
5	2014	10	29	44
6	2015	19	40	59
7	2016	31	37	39
8	2017	17	46	42
9	2018	29	31	45
10	2019	25	40	62



Design of Traffic Light signalsonRidhiSidhiChorahaBy Webster method

Weekly Summary From Shiprapath To Ridhisidhi Choraha

Time	Car/jeep	Three-wheeler	Two-wheeler	Cycle	Bus	Tractor	Truck	Multi-axle
Day1	2260	51	5232	105	75	22	14	12
Day2	2197	57	3642	9	56	27	25	14
Day3	1955	51	5219	10	18	22	8	8
Day4	1829	70	6589	10	23	20	6	9
Day5	2259	26	5789	12	14	13	8	5
Day6	2199	22	4935	9	28	30	11	6
Total	12699	277	31406	155	214	134	72	54

Weekly Summary FromRidhisidhiTo Gopalpura Mode

Time	Car/jeep	Three-wheeler	Two-wheeler	Cycle	Bus	Tractor	Truck	Multi-axle
Day2	435	435	9928	92	164	26	50	11
Day2	8649	390	11019	127	161	22	22	20
Day3	8389	394	10329	137	161	35	21	15
Day4	8354	425	10399	124	151	26	17	22
Day5	8515	406	10389	152	94	25	21	19
Day6	8189	404	6635	126	146	30	26	28
total	50629	2454	58699	758	877	164	157	115



This method is based on the normal flow of the traffic and the saturation flow of the traffic Width of one side main street 1 is 16 meter and width of one side second street is 8 meter

Car	1795	1	1795
Moter cycle	2100	0.75	1575
Auto	92	1.2/2	184
Bus	35	2.2	77
Tractor	15	5	75
Cycle	26	0.2	6
Multi axial	5	2.3	9
Total	Vehicle	Pcu unit	3721

Vehicle type	Vehicle number	Pcu unit	Vehicle in pcu unit
Car	460	1	460
Scooter	1000	0.75	750
Auto	15	1.2/2	30
Bus	06	2.2	13
Tractor	05	5	25
Total			1278

Flow on main road(A) is 3721 vehicles pcu/hr and
Flow on second road(B) is 1278 vehicles pcu/hr

Flow on perlane of main road (Na)= $3721/5 = 744.2$ vehicles /hr/lane
And flow on per lane second road (Nb) = $1278/2=639$ vehicles/hr/lane

Na and Nb=Normal flow in road A/B in veh/hr/lane

Sa and Sb = Saturation flow in road A/B in veh/hr/lane

Saturation Flow of main road (Sa)= $525*16/5=1680$ vehicles/hr/lane

Saturation Flow of second road (Sb)= $525*8.01/2=2102$ vehicles/hr/lane

Ya=Ratio of normal flow to saturation flow of main (A) road

Yb=Ratio of normal flow to saturation flow of second(B) road

$Y_a = N_a/S_a$ and $Y_b = N_b/S_b$

$Y_a = 744.2/1680 = 0.443$

$Y_b = 639/2102 = 0.303$

$Y = Y_a + Y_b$

$Y = 0.746$

Optimum cycle time $C_o = 1.5L + 5/1 - Y$

$C_o = (1.5*20 + 5) / (1 - 0.746)$

=138 sec

L=Total lost time, n= number of lanes

$L = 2n + R$

R=all red time required for pedestrian to cross the road

Ga=Green time for main road= $Y_a/Y * (C_o - L)$ sec

$0.443/0.746 * (138 - 20)$

70 sec

Gb=Green time for second road

= $Y_b/Y * (C_o - L)$ sec

= $0.303/0.746 * (138 - 20)$

47 sec

So, the cycle timing of 138 sec planned is okay.

The aspect of the signal timing is given below,

Street	Green Time, G second	Amber period , Y second	Red time, R Second	Cycle period, C second
Street 1	70	4	64	138
Street 2	47	4	88	138

VI. CONCLUSION

As from the given statistical analysis of accident data on black spot in Jaipur some ideas are conclude to decreases down the rate of accident.

At Ridhi Sidhi Circle re-design the signal because previous optimum cycle time is 125 sec but according to latest data it should be 138 sec So we can control the traffic flow. and also, by providing the proper tapering at the edge we can control the accident.

Chomu Pulia: Decreasing down the diameter of central island also by providing the signalized channel section.

B2 Bye Pass: By providing speed breaker and also by providing a gooddivider with good plantation so that the glazing not occurs in drivers' eyes.

VII. ACKNOWLEDGMENT

My heart pulsates with the thrill for tendering gratitude to those persons who helped me in completion of the project. The most pleasant point of presenting a thesis is the opportunity to thank who have contributed to it. I extend my deep sense of gratitude and indebtedness to my guide Mr. Deepak Mathur (Asst. Prof.) Department of Civil Engineering, KITE, Jaipur, and Raj Yadav KITE Jaipur for their kind attitude, invaluable guidance, keen interest, immense help, inspiration and encouragement which helped me carrying out my present work.

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