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Influence of Pedestrian on Traffic

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Abstract: Roads make a key role to economic development and growth and take important social benefits. They are of vital importance in order to make a nation grow and develop. In addition, providing access to employment, social, health and education services makes a road network crucial in fighting against poverty. Because of population, economic development, vehicular ownership growth, increasing traffic demands beyond the carrying capacity of the roads which is causing traffic congestion. Pedestrians walking without regard for approaching on the several zebra crossings are causing the traffic mess, especially during rush hours. One of the main causes of traffic jam is pedestrian rushing to cross the road in the morning. The traffic police manning the zebra crossing are stopping vehicles to let even a single pedestrian pass. There should at least be five to six pedestrians waiting before they stop the vehicle. This is the main cause of traffic jam along the busy road. The objective of the present study is to control the traffic jam by proposing the correct choices of the selected road network. The selected study site is the spiritual capital of Andhra Pradesh i.e. Tirupati city.
Keywords: Traffic Congestion, Zebra Crossing, Pedestrian pass, Road Network.

1. Introduction

A pedestrian crossing or crosswalk is a designated point on a road at which some means are employed to assist pedestrians wishing to cross. Some times for improving pedestrian safety and intersection capacity, pedestrians are segregated from the way of motor vehicles by overpasses and underpasses. But Pedestrian chooses the shortest route for crossing the roadway and they want to minimize travel time. Pedestrian also have a basic resistance to change grades when crossing the roadways. They do not voluntarily make use of special pedestrian facilities such as overpasses and underpasses because they need easy way.
The Ministry of Road Transport and Highways (MORTH) is a ministry of the Government of India, that is the apex body for formulation and administration of the rules, regulations and laws relating to road transport, transport research and in also to increase the mobility and efficiency of the road transport system in India. Through its officers of Central Engineering Services (Roads) cadre it is responsible for the development of National Highways of the country.

Road transport is a critical infrastructure for economic development of the country. It influences the pace, structure and pattern of development. In India, roads are used to transport over 60 percent of the total goods and 85 percent of the passenger traffic. Walking is one of the most important travel modes in every country. However, pedestrians are always neglected in transportation planning and management. With the development of environment friendly and resource saving society, pedestrians are getting more and more attention. A pedestrian can be termed as a person who travels on foot. Any person walking, running, standing or sitting on a road, a pram or in a mobility device or persons in a toy vehicle not capable of exceeding 10 Km/h is known as pedestrian. It also includes dismounted cyclists.

Pedestrian spaces are becoming increasingly rare nowadays. With the importance imparted to vehicular modes of travel, in the planning and a design of transportation systems, pedestrians are not taken into account. The capacity to respond to pedestrian safety is an important component of efforts to prevent road traffic injuries

Various studies have demonstrated the benefits that could accrue to a city by the creation of proper pedestrian spaces - improvement in circulation of people, better areas for shopping, attraction for tourists, higher rental values, increased opportunities for leisure, better environment for

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residential areas, helps in environmental protection, increased scope for conservation, helps in promoting intellectual social relations and in projecting a better image of the town and its administration. The movement of pedestrians in the urban environment is vital for sustaining the social and economic relationships essential to city life.

Most of the research in transportation sector has been conducted only on vehicle delay at signalized intersections. Highway Capacity Manual (HCM), the most referred manual for development of roadways also focuses on the estimation and improvement of vehicle delay models at signalized intersections.

Pedestrian delay at signalized intersection is more complex to estimate accurately because of pedestrian crossing behaviours and mixed traffic conditions. Thus, pedestrian delay is the key performance indicator to evaluate a signalized intersection Level of Service (LOS) for pedestrians. Generally used pedestrian delay estimation methods and models are mostly derived from HCM and that model is based on cycle length and red phase duration; also with few assumptions such as uniform pedestrian arrival rate, noncompliance pedestrian flow, fixed cycle length and pedestrians following the base rules without violating them. These assumptions are not suitable for Indian mixed traffic conditions and thus the model proposed by HCM is inefficient to estimate pedestrian delay for mixed traffic condition.

In recent times, research works on pedestrian delay due to vehicle pedestrian interaction in crosswalks have been very less. Existing models are also based on pedestrian safety application only. If there is an acceptable gap with no person to manage the signalized intersection, pedestrians violate the traffic signal and try to cross from near side road and reach median or refuge islands. Violators are then waiting for next acceptable gap to cross to the far side road. In this situation, violators face delay in median or crosswalk because of vehicle movement and cause inconvenience to flowing traffic.

During green phases, pedestrians get delayed due to irregular vehicle drivers who disobey traffic rules and cross the intersection and also from vehicles occupying the crosswalks partially or completely. Most of the existing delay models ignore pedestrian delay received during green phases by such vehicle interaction on crosswalk. Therefore, in this paper all of the above mentioned traffic conditions and pedestrian behaviours prevailing in developing cities in India are considered and proposed to develop a new pedestrian delay model at signalized intersections. Finally conclusions and recommendations for future studies are provided. Similar effects are observed for gender and the formation of pedestrian groups. The 15th-percentile value obtained by DiPietro and King (1970) was found to be 0.76 m/s for individual pedestrians, 0.67 m/s for pedestrians in groups of two, and 0.61 m/s for pedestrians in groups of three and four. Broken down by gender, the 15th-percentile value for male pedestrians was 0.67 m/s and that for female pedestrians was 0.58 m/s. Wilson and Grayson (1980) found no statistically significant difference in the average speeds of male (1.32 m/s) and female (1.27 m/s) pedestrians. The average and 15th percentile pedestrian speeds were 1.34 and 1.11 m/s, respectively.

1.1. Objectives

The present study is carried out with the following objectives. They are:

- To select a study location on urban roads where the pedestrian is crossing at undesignated locations.
- To collect the traffic data on the selected study stretches.
- To analyze the impact of pedestrian crossing on urban traffic characteristics.
- To recommend pedestrian warrants for safe movement of pedestrians.
- To study the traffic characteristics on roads with pedestrian and roads without pedestrian locations.

2. Literature Survey

Precision agriculture uses technology to make farming more efficient and sustainable. One important part of this is managing fertilizer use. AI and machine learning (ML) can help by recommending the right fertilizer for different crops based on things like soil, weather, and crop type. This survey looks at how different machine learning techniques, especially Random Forest (RF), have been used for fertilizer recommendations [1].

Munish Kumar et.al., (2017) Various studies have demonstrated the benefits that could accrue to a city by the creation of proper pedestrian spaces improvement in circulation of people, better areas for shopping, attraction for tourists, higher rental values, increased opportunities for leisure, better environment for residential areas, helps in environmental protection, increased scope for conservation, helps in promoting intellectual social relations and in projecting a better image of the town and its administration.

Gowri Asaithambi et.al., (2015) The main motivation of this study is to investigate the changes in pedestrian road crossing behaviours of an intersection under mixed traffic conditions before and after signal installation. For this

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purpose, traffic and pedestrian data were collected from an intersection located in Mangalore city. Different parameters like age, gender, crossing patterns, crossing times, waiting times and crossing speeds of pedestrians, speed and types of vehicles and vehicular flows were extracted from the videos.

Philip Stocker et.al., (2015) The road is a built environments that should enhance safety and security for pedestrians, but this ideal is not always the case. This article presents an overview of the evidence on the risks that pedestrians face in the built environment. This article shows that design of the roadway and development of different land uses can either increase or reduce pedestrian road traffic injury. Planners need to design or modify the built environment to minimize risk for pedestrians.

Granie, M A., Brenac, et.al., (2014) pedestrian behavior being strongly dependent on biological gender, as shown sin past researches, it has also been found to depend on the psychological masculinity of an individual. Pedestrian speeds are also significantly related to pedestrian age, and the speeds of pedestrians are slower as they get older.

Holland and Hill (2010) collected adult pedestrian accident data which demonstrated that the risk of being killed or seriously injured varies with age and gender. A range of factors affecting road crossing choices of 218 adults aged 17- 90 were examined in a simulation study using filmed real traffic. With increasing age, women were shown to make more unsafe crossing decisions, to leave small safety margins and to become poorer at estimating their walking speed. However, the age effects on all of these were ameliorated by driving experience. Men differed from women in that age was not a major factor in predicting unsafe crossing decisions.

Diaz (2002) Male pedestrians are more willing to violate regulations and make unsafe crossing decisions. They are also less likely to perceive risk when crossing a roadway in the presence of motor vehicles.

D. Asin and V.P. Sisiopiku (2002) Pedestrian user survey which sought pedestrian perceptions toward various pedestrian facilities in a divided urban boulevard located next to a large university campus, Michigan State University, East Lansing, MI, USA such facilities included signalized and unsignalized crosswalks, unsignalized marked and non-striped mid-block crosswalks, physical barriers (vegetation and two-foot high concrete wall), mid-block crosswalks shelters, coloured paving(red brick pavement) at medians and curbs, and pedestrian warning signs at mid-block.

3. Methodology

3.1. Selection of Study Location

Various sites in and around the Tirupati city were inspected and the site conditions were analysed. The best site with better geometrical conditions and suitable traffic conditions is selected for the study. After analysing different locations of site best possible location was selected by considering every traffic parameter and factors that are required for the execution of the present study. The stretch which accepts all the parameter and factors was adopted and further process pf the study were executed on the stretch.

Figure.1 Various sites visited for selection

3.2. Study Area

Selection of site is done based on traffic operations on roads with pedestrians and roads without pedestrians.

- One lane Road
- Two lane Roads
- Four lane Roads

Figure.2 Selected study stretch

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3.3. Geometric Details Of The Selected Road Stretch At B.C.M School Road In Tirupati

- Width of each lane = 3.5m
- Width of the carriage way = 14m
- Unpaved Shoulders

Figure.3 Geometry of the selected study stretch at BCM School Road, Tirupati

3.4. Geometric Details Of The Selected Road Stretch At Thondawada Highway, Tirupati

- Width of each lane = 3.8m
- Width of the carriage way = 15.2m
- Paved Shoulders
- Width of the shoulders on each side = 0.5

Figure.4 Geometry of the selected study stretch at Thondawada Highway, Tirupati

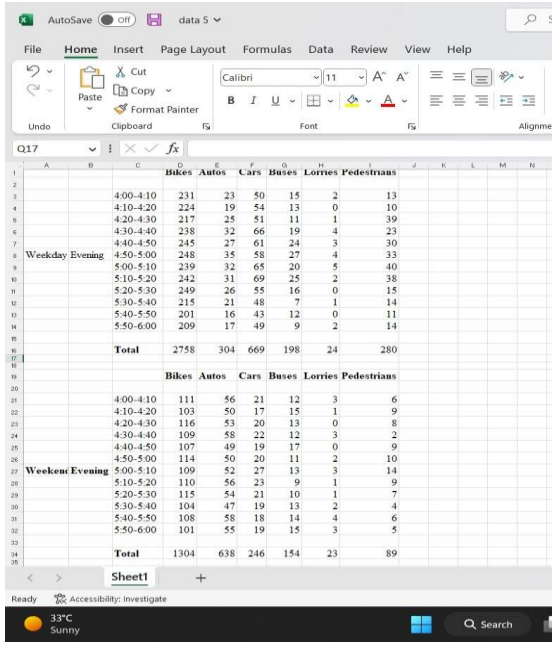
3.5. Data Collection Using Videography Method

The data Required is collected by using videography technique for a time period of 1 hour during peak hours of weekdays and weekends

3.5.1. Identification of Peak Hour

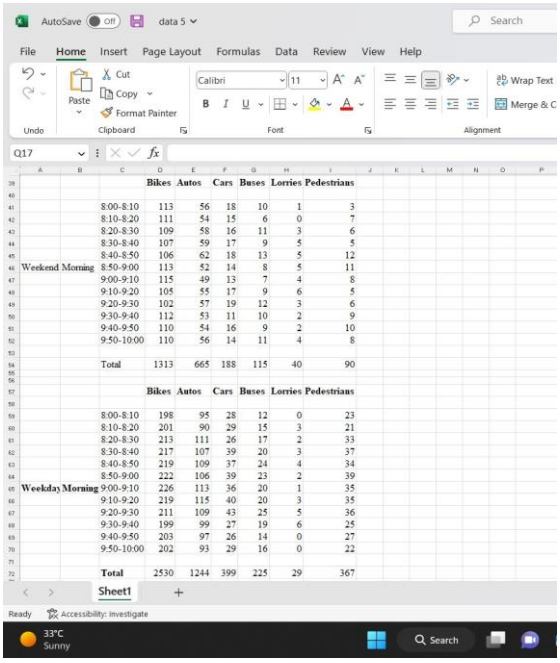
Peak hour was identified by visiting the Stretch manually and counting number of vehicles that passes through every minute for an time period of 2-3 hours during weekdays and weekends using TRAFFIC COUNTER LITE application. Application used was an free source application which was readily available in play store for most of the android devices. Data obtained from field was intercepted into an excel sheet for further data extraction. A excel sheet was prepared form the data obtained during field visits for every different category of vehicle. This sheets represents total number of vehicles of every category passing through the specific stretch for every minute.

This 1 minute data was converted into 10 minute data and 1hour data to determine the peak hour and volume of traffic in that stretch. Obtained excel sheet was analyzed and peak hours during morning 7 7:45 am- 8:45 am and evening 5 pm-6 pm were identified.



		Bikes	Autos	Cars	Buses	Lorries	Pedestrians
	4:00-4:10	231	23	50	15	2	13
	4:10-4:20	224	19	54	13	0	10
	4:20-4:30	217	25	51	11	1	39
	4:30-4:40	238	32	66	19	4	23
	4:40-4:50	245	27	61	24	3	30
Weekday Evening	4:50-5:00	248	35	58	27	4	33
	5:00-5:10	239	32	65	20	5	40
	5:10-5:20	242	31	69	25	2	38
	5:20-5:30	249	26	55	16	0	15
	5:30-5:40	215	21	48	7	1	14
	5:40-5:50	201	16	43	12	0	11
	5:50-6:00	209	17	49	9	2	14
	Total	2758	304	669	198	24	280

		Bikes	Autos	Cars	Buses	Lorries	Pedestrians
	4:00-4:10	111	56	21	12	3	6
	4:10-4:20	103	50	17	15	1	9
	4:20-4:30	116	53	20	13	0	8
	4:30-4:40	109	58	22	12	3	2
	4:40-4:50	107	49	19	17	0	9
	4:50-5:00	114	50	20	11	2	10
Weekend Evening	5:00-5:10	109	52	27	13	3	14
	5:10-5:20	110	56	23	9	1	9
	5:20-5:30	115	54	21	10	1	7
	5:30-5:40	104	47	19	13	2	4
	5:40-5:50	108	58	18	14	4	6
	5:50-6:00	101	55	19	15	3	5
	Total	1304	638	246	154	23	89



		Bikes	Autos	Cars	Buses	Lorries	Pedestrians
	8:00-8:10	113	56	18	10	1	3
	8:10-8:20	111	54	15	6	0	7
	8:20-8:30	109	58	16	11	3	6
	8:30-8:40	107	59	17	9	5	5
	8:40-8:50	106	62	18	13	5	12
Weekend Morning	8:50-9:00	113	52	14	8	5	11
	9:00-9:10	115	49	13	7	4	8
	9:10-9:20	105	55	17	9	6	5
	9:20-9:30	102	57	19	12	3	6
	9:30-9:40	112	53	11	10	2	9
	9:40-9:50	110	54	16	9	2	10
	9:50-10:00	110	56	14	11	4	8
	Total	1313	665	188	115	40	90

		Bikes	Autos	Cars	Buses	Lorries	Pedestrians
	8:00-8:10	198	95	28	12	0	23
	8:10-8:20	201	90	29	15	3	21
	8:20-8:30	213	111	26	17	2	33
	8:30-8:40	217	107	39	20	3	37
	8:40-8:50	219	109	37	24	4	34
	8:50-9:00	222	106	39	23	2	39
Weekday Morning	9:00-9:10	226	113	36	20	1	35
	9:10-9:20	219	115	40	20	3	35
	9:20-9:30	211	109	43	25	5	36
	9:30-9:40	199	99	27	19	6	25
	9:40-9:50	203	97	26	14	0	27
	9:50-10:00	202	93	29	16	0	22
	Total	2530	1244	399	225	29	367

Figure.5 Data extracted 0f B.C.M School at weekday

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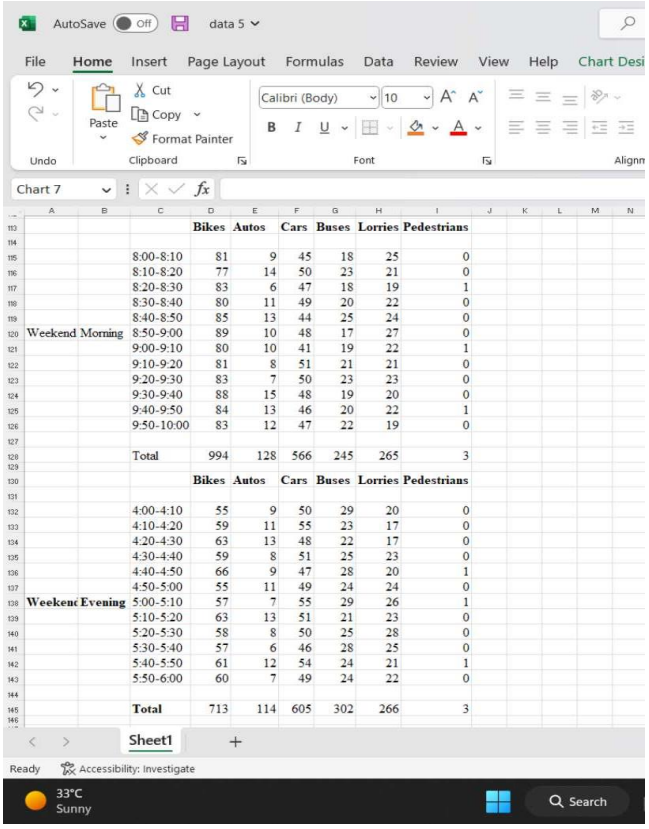
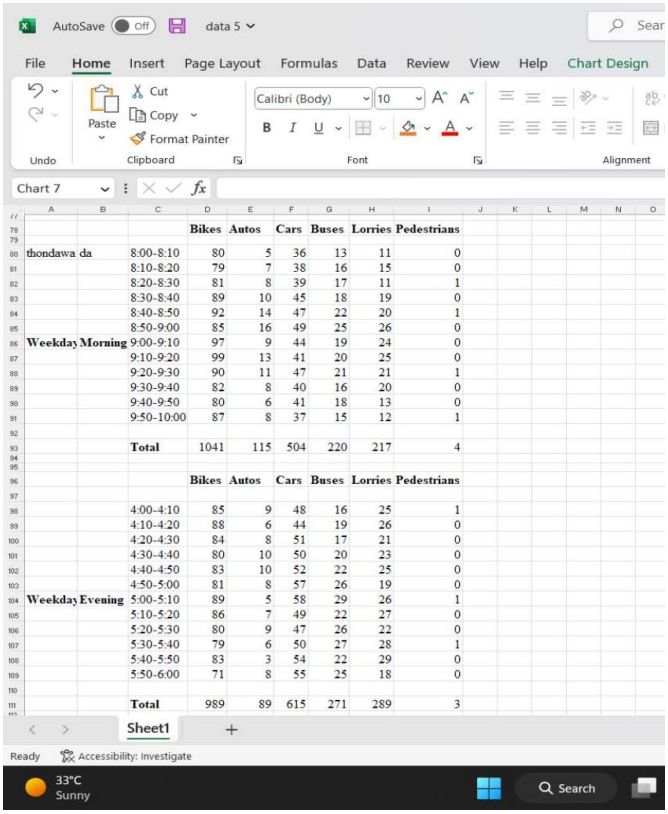


		Bikes	Autos	Cars	Buses	Lorries	Pedestrians
	8:00-8:10	81	9	45	18	25	0
	8:10-8:20	77	14	50	23	21	0
	8:20-8:30	83	6	47	18	19	1
	8:30-8:40	80	11	49	20	22	0
	8:40-8:50	85	13	44	25	24	0
Weekend Morning	8:50-9:00	89	10	48	17	27	0
	9:00-9:10	80	10	41	19	22	1
	9:10-9:20	81	8	51	21	21	0
	9:20-9:30	83	7	50	23	23	0
	9:30-9:40	88	15	48	19	20	0
	9:40-9:50	84	13	46	20	22	1
	9:50-10:00	83	12	47	22	19	0
	Total	994	128	566	245	265	3
		Bikes	Autos	Cars	Buses	Lorries	Pedestrians
	4:00-4:10	55	9	50	29	20	0
	4:10-4:20	59	11	55	23	17	0
	4:20-4:30	63	13	48	22	17	0
	4:30-4:40	59	8	51	25	23	0
	4:40-4:50	66	9	47	28	20	1
	4:50-5:00	55	11	49	24	24	0
Weekend Evening	5:00-5:10	57	7	55	29	26	1
	5:10-5:20	63	13	51	21	23	0
	5:20-5:30	58	8	50	25	28	0
	5:30-5:40	57	6	46	28	25	0
	5:40-5:50	61	12	54	24	21	1
	5:50-6:00	60	7	49	24	22	0
	Total	713	114	605	302	266	3



		Bikes	Autos	Cars	Buses	Lorries	Pedestrians
thondawa da	8:00-8:10	80	5	36	13	11	0
	8:10-8:20	79	7	38	16	15	0
	8:20-8:30	81	8	39	17	11	1
	8:30-8:40	89	10	45	18	19	0
	8:40-8:50	92	14	47	22	20	1
	8:50-9:00	85	16	49	25	26	0
Weekday Morning	9:00-9:10	97	9	44	19	24	0
	9:10-9:20	99	13	41	20	25	0
	9:20-9:30	90	11	47	21	21	1
	9:30-9:40	82	8	40	16	20	0
	9:40-9:50	80	6	41	18	13	0
	9:50-10:00	87	8	37	15	12	1
	Total	1041	115	504	220	217	4
		Bikes	Autos	Cars	Buses	Lorries	Pedestrians
	4:00-4:10	85	9	48	16	25	1
	4:10-4:20	88	6	44	19	26	0
	4:20-4:30	84	8	51	17	21	0
	4:30-4:40	80	10	50	20	23	0
	4:40-4:50	83	10	52	22	25	0
	4:50-5:00	81	8	57	26	19	0
Weekday Evening	5:00-5:10	89	5	58	29	26	1
	5:10-5:20	86	7	49	22	27	0
	5:20-5:30	80	9	47	26	22	0
	5:30-5:40	79	6	50	27	28	1
	5:40-5:50	83	3	54	22	29	0
	5:50-6:00	71	8	55	25	18	0
	Total	989	89	615	271	289	3

Figure.6 Data collection in peak hours at weekend ,Thondawada highway

3.6. Analysing Vehicle Categories

Data was analysed to identify different types of vehicles that passes through the stretch. An excel sheet were prepared for different vehicles to find out their percentage of effect on the traffic flow and volume.

Table.1 Average speed of vehicles at B.C.M School, Tirupati

S.NO	CATEGORY OF VEHICLE	SPEED OF VEHICLE (m/s)
1	Bike	6.84
2	Auto	6.3
3	Car	7.31
4	Bus	7.33
5	**Lorry**	**3.98**

Table.2 Average speed of vehicles at Thondawada Highway, Tirupati

S.NO	Category of Vehicle	Speed of Vehicle (M/S)
1	Bike	9.64
2	Auto	13.2
3	Car	15.9
4	Bus	17.6
5	**Lorry**	**15.3**

3.7. Data Extraction

3.7.1. Software Interface

For the extraction of the collected video data, the collected data is transferred to a system having pre-installed AVIDEMUX 2.6 software in it. Avidemux was an free and open source software for non-linear video editing and transcoding multimedia files.

3.7.2. Data Analysis

The traffic data collected from the selected road stretch is analyzed manually. The volume and speed is primarily calculated. Then the average speed of all the vehicle categories are calculated. Finally the capacity and level of service of the road section is calculated.

3.7.3. Experimental Data Analysis

Speed of Vehicles: The average speeds of vehicles is determined by using formula of Speed = Distance / TimeThe required input data is number of vehicles, entry & exit
time of vehicles at particular distance and Distance of the road.

Step-1: Input data
Step-2: Traffic data collected during peak hours on selected road sections
Step-3: Determination of average speed of vehicles

Data Extracted:

3.7.3.1. Road With Pedestrians:

Average speed of bike Speed = distance/time

S = 30/4.38 = 6.84 m/s

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Average speed of car S = 30/4.06 = 7.38 m/s
Average speed of Auto S = 30/6.45 = 4.65 m/s
Average speed of Bus S = 30/6.88 = 4.36 m/s
Average speed of Lorry S = 30/4.40 =6.81 m/s

3.7.4. Road Without Pedestrians

Average speed of bike Speed = distance/time
S = 30/1.51 = 19.86 m/s
Average speed of car S = 30/1.63 = 18.40 m/s
Average speed of Auto S = 30/1.82 = 16.48 m/s
Average speed of Bus S = 30/2.28 = 13.15 m/s
Average speed of Lorry S = 30/2.52 = 11.90 m/s

4. Results

comparative graph was drawn for both the sections with relation of density vs speed.

Figure.7 Comparing two sites Average speeds Vs Categories of Vehicles [Page. 47]

In BCM School Road, TIRUPATI the pedestrian flow of crossing road at undesignated road is high. In Thondawada Highway , TIRUPATI the pedestrian flow of crossing road is very low hence no need to provide any facilities to cross the road for pedestrians. As comparing two sites of Roads with pedestrian and Roads without pedestrian Speeds of vehicles changes. Change in speed of vehicles occurred with the influence of pedestrian the vehicular are suffering to reach their destination intime at BCM School Road, TIRUPATI. Due to influence of pedestrian the speed of vehicles will change which have chance of occurrences of accidents which will impact both the pedestrians and vehicular. By comparing morning and evening at B.C.M School road, morning has high pedestrian flow which results change in speed of vehicles.

5. Conclusion and Future Scope

The present study compares the variation speeds of vehicles in two conditions based on Area. The selected study area is divided into two sections, where the first section as road with pedestrian and second section as road without pedestrian. The volume and the average speeds of different categories of vehicles i.e., bicycle, autos, cars, buses and lorries are calculated. The reduction of speed at road with pedestrian was reduced than road without pedestrian. Traffic analysis was performed at two sections to recognize the variation in speeds due to pedestrian flow. It is concluded that the speed of vehicles at Road with pedestrian is decreased with disturbance due to pedestrian flow. The speeds of vehicles at BCM School Road is low whereas the speeds of vehicles at Thondawada Highway is high. With the flow of pedestrians in BCM School Road there no chance of free movement of vehicles but at Thondawada Highway their free movement of vehicles with no flow of pedestrians. The volume of vehicles per hour is reduced at road with pedestrians(BCM School Road) where as in road without pedestrians(Thondawada Highway) the volume of vehicles per hour is high.

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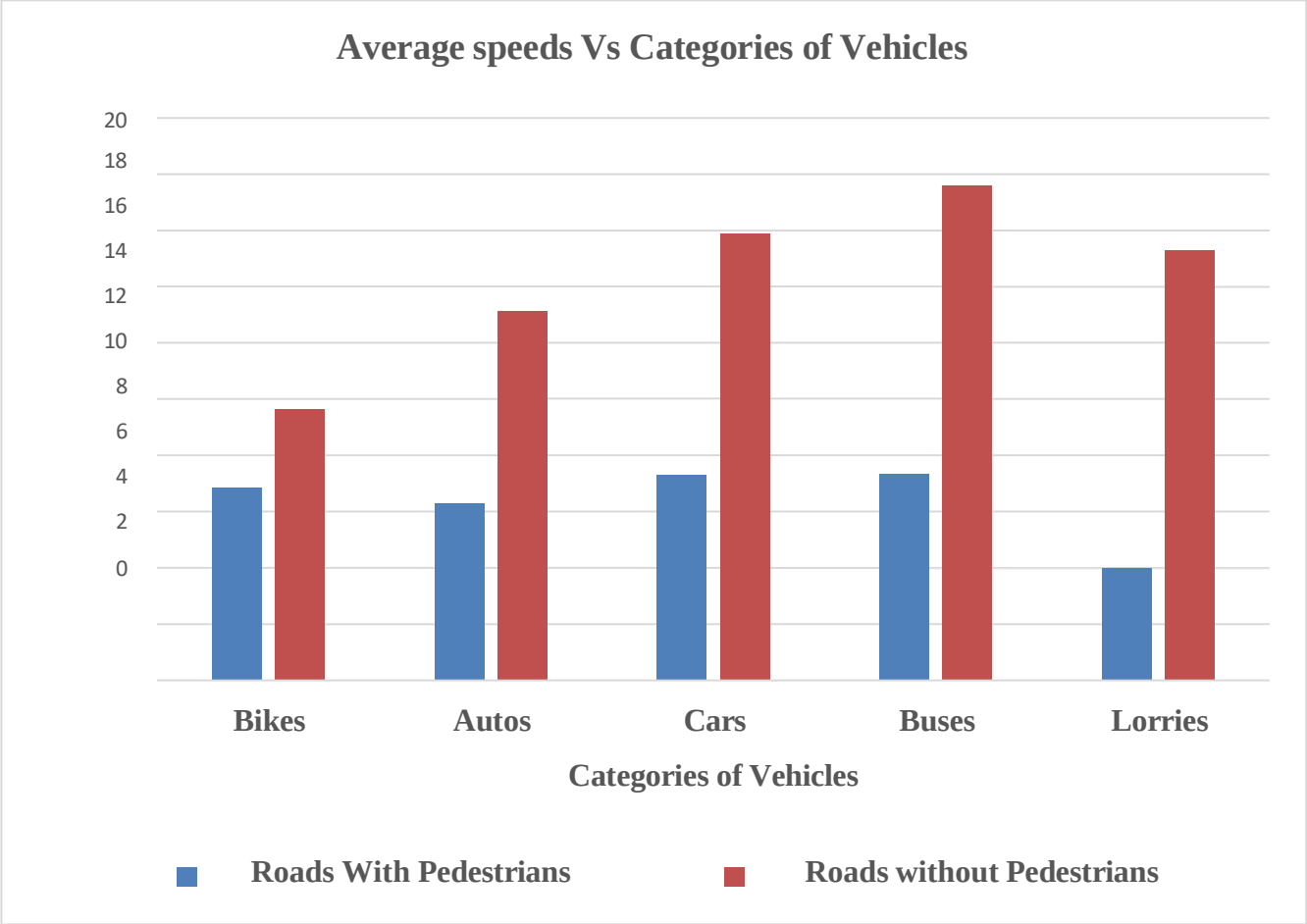
Figure.7 Comparing two sites Average speeds Vs Categories of Vehicles



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