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Design and Fabrication of Smart E-Bike

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Abstract

In this paper, we are concerning about the growing demand of energy all over the world, which motivate us to switch over renewable resource of energy. There are many different ways by which we can save energy in different sectors. Our main focus is on automobile sector where we are converting old petroleum bike to electric bike. In these electric bikes we use electrical motor (BLDC motor) instead of combustion engine as there is less pollution, low maintenance cost, reduces noise. These bikes utilize chemical energy stored in the rechargeable battery packs. This paper deals with the design and development of electric bike which make use of electric energy as primary source. There is a distribution for charging the battery emitting it from the main system. An agile approach (responsive design) for web application development has been applied, giving possibility for work with it on desktop, smart phone and tablets. Implementation of this concept is done, reference architecture of IOT has been implemented and the advantages of the use of common reference model of IOT have been outlined.

Index Terms: Hybrid electrical vehicle, BLDC motor, electric bike, lithium- ion battery

Introduction

Automotive sector is considered as the main important sector to increase the economical growth of any country. The advancement in the technology enables the automotive industry to develop new design vehicles to meet stringent requirements of customers such as effective braking performance, safety, low cost and aesthetic appearance. The present trend in the automotive sector is to design and develop electrical vehicles to give same performance like petrol and diesel vehicles. Therefore, many industries are trying to design new type of electrical vehicles to meet with the present challenges such as zero emissions vehicle. Due to the petroleum crisis and polluting effects in world, nowadays trend is seen in automobile industry to switch to electric vehicles. Efforts are being taken on performance improvement of electric vehicles and considerable success is also obtained. Fuzzy logic based system is described to determine the range of the electric vehicle. In this context, more capacity batteries are being introduced to give better performance and improve mileage capacity of the vehicle. Few peoples are doing their research to incorporate graphite and other carbon based materials to store the energy for longer time and improve the performance of the vehicle. There is only limited research done on the analysis of electrical vehicles. Introduction To E-Bike: The main reason to design the electric bike is to overcome the problem with the pollution and with the economy. Future E bike is the best technical application as a solution for the better world and upcoming generation. The E bike is a battery operated vehicle that is very economical with low maintenance cost and less pollution. E bikes are an attractive alternative to both conventional bicycles and traditional automobiles, providing an environmentally friendly, fun, efficient and convenient way to travel. E-bikes are driven with the help of battery which is coupled with electric motor. Introduction to Methodology accepted: E- Bike is the plug-in electrical vehicles with two or three wheels. The power on which this bike works is stored in a rechargeable battery which drives the motor. Now a day's these motorbikes are manufactured at a very large scale. Typical parts used in E-bike are BLDC motor, battery, controller, throttle, chain set. The performance of the BLDC motor driver is analyzed. After precise control of the motor and tyre assembly, the other subsystems like speedometer, indicator, accelerator, horn, braking system etc. are developed and tested. Motor controller and status monitoring controller acts in coordination due to which in any faulty or abnormality situation both interacts with each other to take necessary action. Importance and Selection of Manufacturing Processes: Manufacturing is a series of complex interaction between materials, machines, energy and people. It begins with creation of individual parts that are finally assembled to produce final product. Every method of production uses its own basic principles for impacting desired shape, accuracy and surface finish. There are many factors involved in selection of appropriate manufacturing process. However, the selection is usually made on the basis of the following considerations:

1. Materials to be used
2. Shape and size of the components
3. Accuracy and surface finish
4. Volume of production
5. Economy.

Methodology and Experimental Work: The material selection of an automobile plays a vital role for giving strength to the automobile. The load with standing capability primarily depends on the selection of materials. Steels are generally used in the automobile for sustaining low loads acting on the automobile. Many times, high alloy steels are used in automotive industry for manufacturing many components subjected to complex loads such as shaft, coupling, chassis etc. to sustain heavy loads acting on the automobile. Now a day's composite materials are widely used in automobiles to produce light weight, corrosion resistant and also for giving aesthetic appearance. In this study different materials are considered for analyzing the behavior of frame of two wheeler electrical bike against static and impact loads. The behavior of standard existing material of frame such as AISI 1020 is compared with remaining materials (G-CI, ST-S, CF-E, Ti-Al, and Al-Al).The mechanical properties of all the materials are given below. Table 1 and Table 2 give chemical composition and mechanical properties of AISI 1020 steel material. Here we used mild steel as our frame material because of cost reduction and also though it is a prototype. The more details about the frame and details are given in below sections.

Technical Specifications:

Table 1. Dimensions Considered For Design

SI.NO	Variable	Specification
1	Wheel Base	1410 mm
2	Front Trail	110 mm
3	Front Wheel	90/80-17"
4	Rear Wheel	130/70-17"
5	Rake Angle	23.27
6	Motor Power	1200 W
7	Front Suspension	Telescopic Fork
8	Rear Suspension	Telescopic

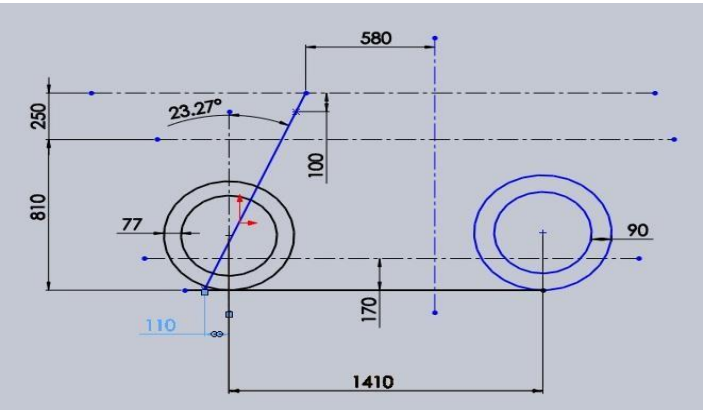


Figure 1. Two dimensional drawing of E-Bike

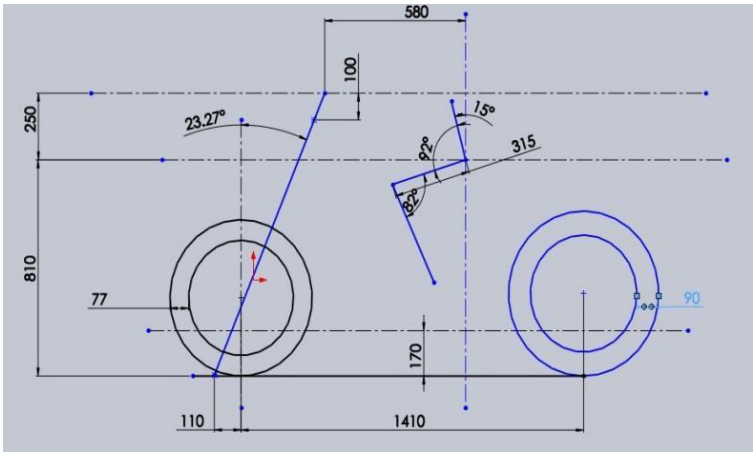


Figure 2 Ergonomics and Dimensions

Design Approach Details:

1) Since it is a street sports bike, we have given importance to ergonomics.

Based on the ergonomic standards of various two-wheeler manufacturers the following body posture is decided:

1. Seat height = 810 mm
2. Back angle = 15°
3. Knee angle = 82°
4. Distance between handle and shoulder = 580mm.

2) The next important parameter is the space occupied by batteries. The energy required was calculated to be 1.2 kWh to comply with the power output in competition, since it is the most commonly used motorcycle in Indian market. After doing a survey and contacting various battery suppliers, here choose the Amaron BL400LMF Lead Acid battery as highlighted its specifications and dimensions.

Table 2. Battery Specification

Name Of The Manufacturer	**Voltage (V)**	**Amphere (AH)**	**Power (W)**	**Dimensions (mm)**
Amaron	12	32	384	18.2 X 65.1

1) Following is the rough estimate of how the given arrangement will require the space box in the frame.
2) After deciding the space box for batteries, we had to make sure other components such as motor, motor controller, swing arm and front suspension also get the space. Hence the final design of the frame would look like this.

Figure 3 Design Of Frame (Side View)

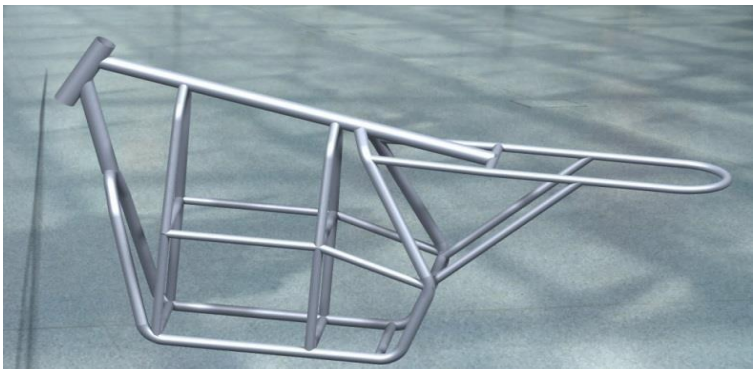


Figure 4 Design Of The Frame

Codes, Standards & Material properties:

For the frame, we have used two ISO standard pipes: 21.3 mm x 2.3 mm and 26.9 mm x 3.2 mm. These are the standard ISO standards typically used and are also default standards available in Solid Works. Analysis of the real time forces on the frame and swing arm with AISI 1020, Aluminium 6063-T6 and AISI 4340. The main reason for choosing these materials for analysis is their ease of access in the market and they are suitable for mass production.

Table 3 Material specification

Sr. No.	Material	Elastic Modulus (N/mm^2)	Poisson's ratio	Shear Modulus (N/mm^2)	Density (kg/m^3)	Tensile strength (N/mm^2)	Yield strength (N/mm^2)
1	AISI 1020	200000	0.29	77000	7900	420.51	351.57
2	Aluminium 6063-T6	69000	0.33	25800	2700	240	215
3	AISI 4340	205000	0.32	80000	7850	1110	710

Analysis and forces:

The analysis on the frame was done by fixing the frame about front suspension points. The forces acting on the frame include the weight of the rider and the pillion rider, weight of the battery, weight of the motor, weight of the frame itself and the force due to acceleration (assumed to be maximum at 2g). These forces are fed into the Analysis software ANSYS and simulated. Following are the results of simulation**.**

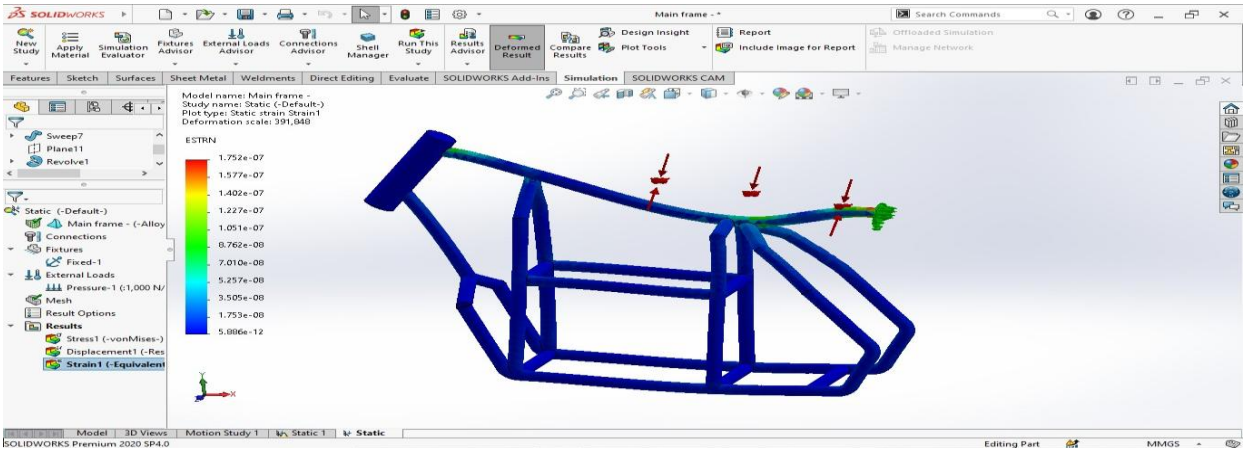


Figure 5 (A) Stress Distribution

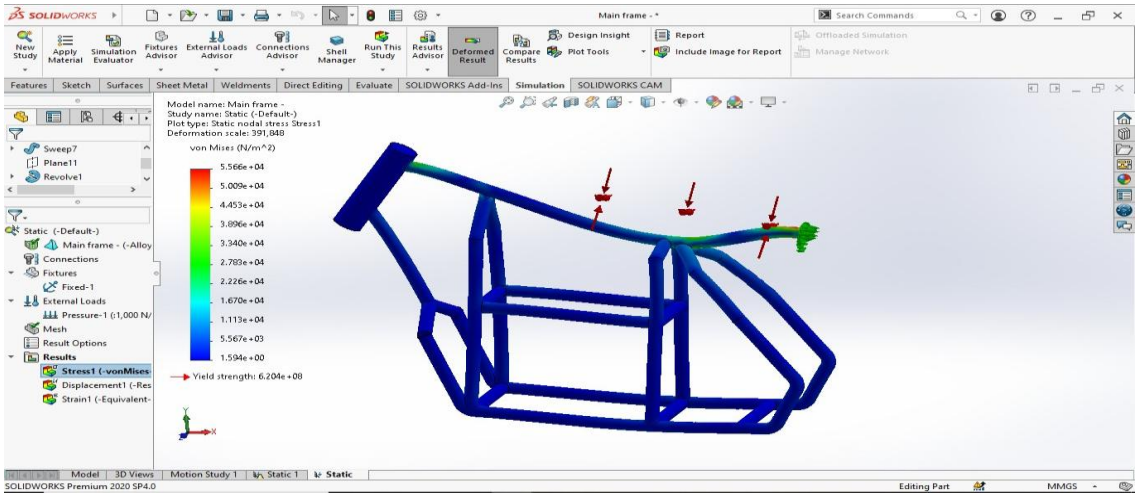


Figure 5 (B) Strain Distribution

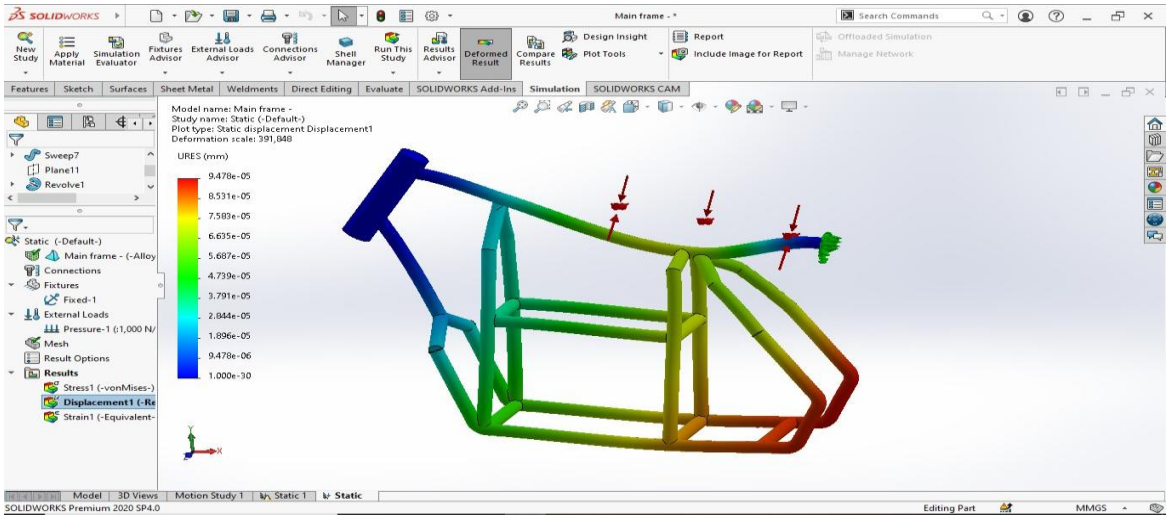


Figure 5 (C) Total Deformations

Figure 6 Components of the E-Bike

Main components of e-bike:

- **BLDC MOTOR:** The motor is having rated power of 1200w capacity with max 500 rpm per min, their specifications are as follows: Rated voltage – DC 48 v Rated current - 13.5 AH Protection level –IP33 Insulation class – f
- **BATTERY:** A lithium ion battery are the rechargeable battery which is used in many electric vehicles now a days in this battery the lithium ions moves from the negative electrode to the positive electrode during discharge and back when charging. It is more efficient as it is less in weight, high speed, no pollution, more reliable.
- **FRAME:** It is the core structure on which other parts are assembled, it supports the motor, provides base for the location.
- **BRAKING SYSTEM:** In this system, kinetic energy is converted into thermal energy by friction. It is used in band brake system which consists of spring loaded friction –shoe mechanism, which is driven with the help of hand lever.
- **CHAIN SET:** It is the more common type of chain drive which is used for transmission of mechanical power to long lasting &better way of rotatory motion from one gear to another it is derived by a tooth head wheel called a sprocket it is simple, reliable and efficient.
- **SPROCKET:** It is the wheel with teeth which holds the chain they are used to transmit rotatory motion between to shafts. It is different from gear as it has many teeth &where as gear consists of only one or two teeth. It is also different from pulley because the pulley works more smoothly

Table 4 Components of E-Bike

S-NO	**COMPONENTS**
1	Front Wheel
2	Fork
3	Horn
5	Indicator
6	IOT Kit
7	Display (Raspberry PI)
8	Mirror
9	Brake wire
10	Throttle
11	Rear Wheel
12	Telescopic Suspension
13	Front Disc Brake
14	Switches(Horn,Light,Indicator,Passing)
15	Drum Brake
16	Chain Sprocket
17	Chain
18	Danger Light / Brake Light
19	Charging Point & Microcontroller
20	Remote control kit
21	Side Body / Battery Cover
22	BLDC Motor

CALCULATIONS:

Load Speed Calculation

Step 1:-

Number of teeth on smaller sprocket (motor) (t1) = 9 Number of teeth on larger sprocket (bike) (t2) = 18 Speed on smaller sprocket (motor) (N1) = 3300 rpm By using reduction ratio (9.78), speed will be reduced to338 rpm Speed on larger sprocket (bike) (N2) = ?

Step 2 :-
Using speed ratio formulae, N1t1 = N2t2
N2 = 169 rpm
Step 3:-
Diameter of wheel =650mm
Circumference of wheel =3.14*650=2041mm
Step 4:-
Speed of vehicle = speed of wheel*circumference of Wheel =169*2041
=344418075 mm/min
=344.41 m/min=20665 m/hr=20.66 Km/hr
Required Power to Drive Bicycle
Step (1)
Total load act on bike is as follow
Normal weight of person =60 kg=60*9.81=588.6 N Weight of bicycle = 100 kg=100*9.81=981 N Other Miscellaneous load =5 Kg=5*9.81= 49.05 N The total load = (588.6+981+49.04)= 1618.64 N
Step (2)
To find reaction on each wheel ,The above total load which is divided equally on both wheel
Force (Ffw) =Force(Frw)=681/2=340.5N
Where reaction on rear and front wheel are as follows Rfw=Rrw
=0.2*340.5
=68.1 N
Step (3)
To find torque on each wheel Total torque=Tfw+Trw
To find Torque on Front Wheel
T1 = Rfw*(D÷2)
=68.1*[(65*10-2)/2]
=22.1325Nm T1=T2=22.1325Nm
Total torque on wheel= 22.90 Nm
Step(4)
To find power on motor = 1200 watt

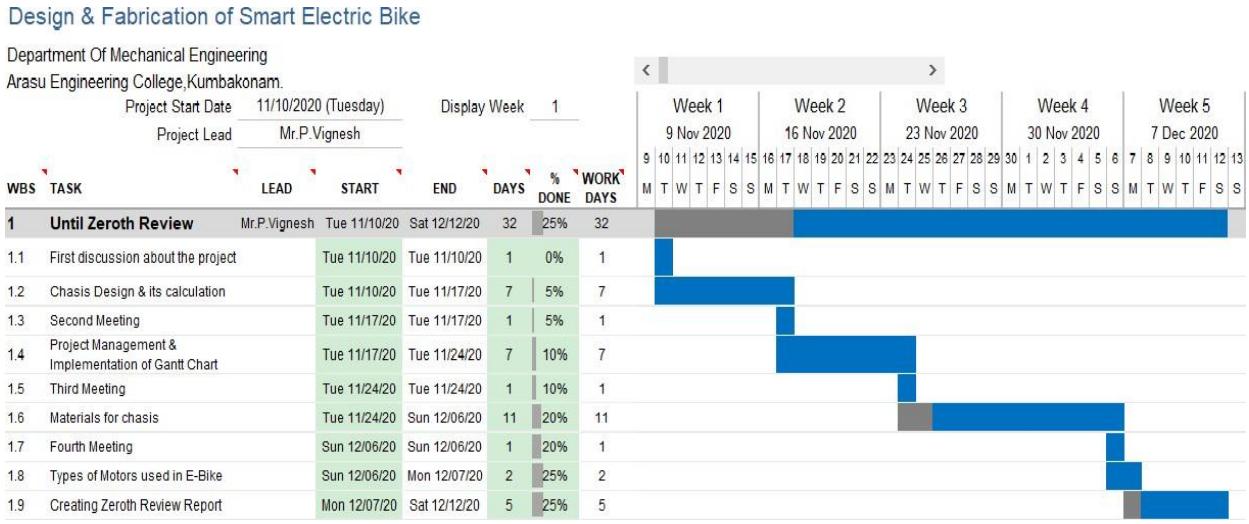
Table 5– Specifications of E-Bike

PARAMETER	**VALUES**
TORQUE	22.90 Nm
SPEED	LOW SPEED – (0-20 KMPH)
	MEDIUM SPEED – (0-39 KMPH)
	HIGH SPEED – (0-49 KMPH)
MILEAGE	159 KM (IN SINGLE CHARGE)

RESULTS AND DISCUSSIONS
The main concern in design of electric bike is the motor driving converter. It should be designed considering the reliability aspects. For reliability improvement following precautions must be taken:

1. Power switches i.e. MOSFET or IGBT should be of suitable rating. Heat sinks of appropriate dimensions should be selected.
2. Gate driving circuitry of higher reliability should be selected.
3. Power line paths should be of sufficient width.
4. Battery charging circuitry should charge the battery in proper manner for its long duration survival.
5. Status monitoring circuits, indicators should be connected to converter and battery.
6. MCBs/ fuses should be connected at suitable places to ensure SC protection.

Gantt chart:
A Gantt chart is a type of bar chart that illustrates a project schedule, named after its inventor, Henry Gantt, who designed such a chart around the years 1910 – 1915.Modern Gantt chart also show the dependency relationships between activities and the current schedule status.



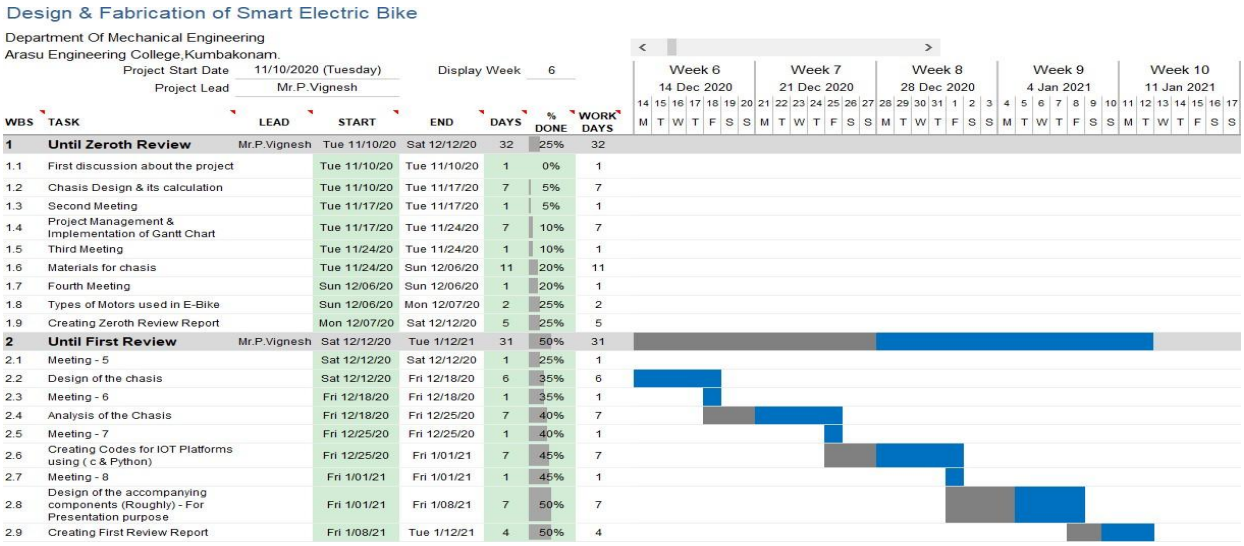
Design & Fabrication of Smart Electric Bike

Department Of Mechanical Engineering
Arasu Engineering College,Kumbakonam.

Project Start Date 11/10/2020 (Tuesday) Display Week 1
Project Lead Mr.P.Vignesh

WBS	TASK	LEAD	START	END	DAYS	% DONE	WORK DAYS
1	**Until Zeroth Review**	Mr.P.Vignesh	Tue 11/10/20	Sat 12/12/20	32	25%	32
1.1	First discussion about the project		Tue 11/10/20	Tue 11/10/20	1	0%	1
1.2	Chasis Design & its calculation		Tue 11/10/20	Tue 11/17/20	7	5%	7
1.3	Second Meeting		Tue 11/17/20	Tue 11/17/20	1	5%	1
1.4	Project Management & Implementation of Gantt Chart		Tue 11/17/20	Tue 11/24/20	7	10%	7
1.5	Third Meeting		Tue 11/24/20	Tue 11/24/20	1	10%	1
1.6	Materials for chasis		Tue 11/24/20	Sun 12/06/20	11	20%	11
1.7	Fourth Meeting		Sun 12/06/20	Sun 12/06/20	1	20%	1
1.8	Types of Motors used in E-Bike		Sun 12/06/20	Mon 12/07/20	2	25%	2
1.9	Creating Zeroth Review Report		Mon 12/07/20	Sat 12/12/20	5	25%	5

Figure 7– Gantt chart Until Zeroth Review



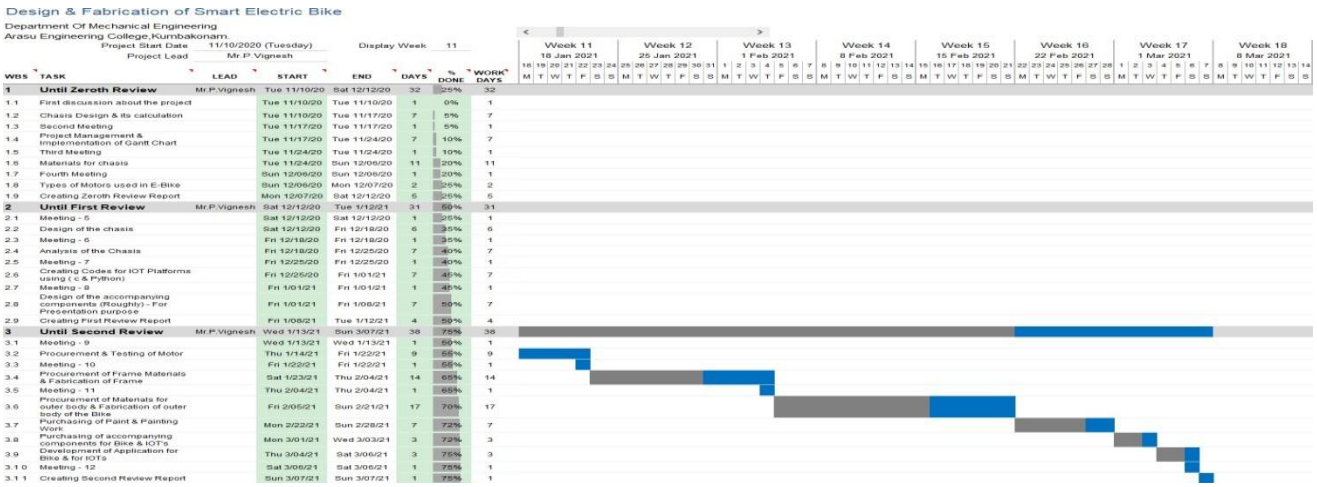
Design & Fabrication of Smart Electric Bike

Department Of Mechanical Engineering
Arasu Engineering College,Kumbakonam.

Project Start Date 11/10/2020 (Tuesday) Display Week 6
Project Lead Mr.P.Vignesh

WBS	TASK	LEAD	START	END	DAYS	% DONE	WORK DAYS
1	**Until Zeroth Review**	Mr.P.Vignesh	Tue 11/10/20	Sat 12/12/20	32	25%	32
1.1	First discussion about the project		Tue 11/10/20	Tue 11/10/20	1	0%	1
1.2	Chasis Design & its calculation		Tue 11/10/20	Tue 11/17/20	7	5%	7
1.3	Second Meeting		Tue 11/17/20	Tue 11/17/20	1	5%	1
1.4	Project Management & Implementation of Gantt Chart		Tue 11/17/20	Tue 11/24/20	7	10%	7
1.5	Third Meeting		Tue 11/24/20	Tue 11/24/20	1	10%	1
1.6	Materials for chasis		Tue 11/24/20	Sun 12/06/20	11	20%	11
1.7	Fourth Meeting		Sun 12/06/20	Sun 12/06/20	1	20%	1
1.8	Types of Motors used in E-Bike		Sun 12/06/20	Mon 12/07/20	2	25%	2
1.9	Creating Zeroth Review Report		Mon 12/07/20	Sat 12/12/20	5	25%	5
2	**Until First Review**	Mr.P.Vignesh	Sat 12/12/20	Tue 1/12/21	31	50%	31
2.1	Meeting - 5		Sat 12/12/20	Sat 12/12/20	1	25%	1
2.2	Design of the chasis		Sat 12/12/20	Fri 12/18/20	6	35%	6
2.3	Meeting - 6		Fri 12/18/20	Fri 12/18/20	1	35%	1
2.4	Analysis of the Chasis		Fri 12/18/20	Fri 12/25/20	7	40%	7
2.5	Meeting - 7		Fri 12/25/20	Fri 12/25/20	1	40%	1
2.6	Creating Codes for IOT Platforms using (c & Python)		Fri 12/25/20	Fri 1/01/21	7	45%	7
2.7	Meeting - 8		Fri 1/01/21	Fri 1/01/21	1	45%	1
2.8	Design of the accompanying components (Roughly) - For Presentation purpose		Fri 1/01/21	Fri 1/08/21	7	50%	7
2.9	Creating First Review Report		Fri 1/08/21	Tue 1/12/21	4	50%	4

Figure 8--Gantt chart until First review



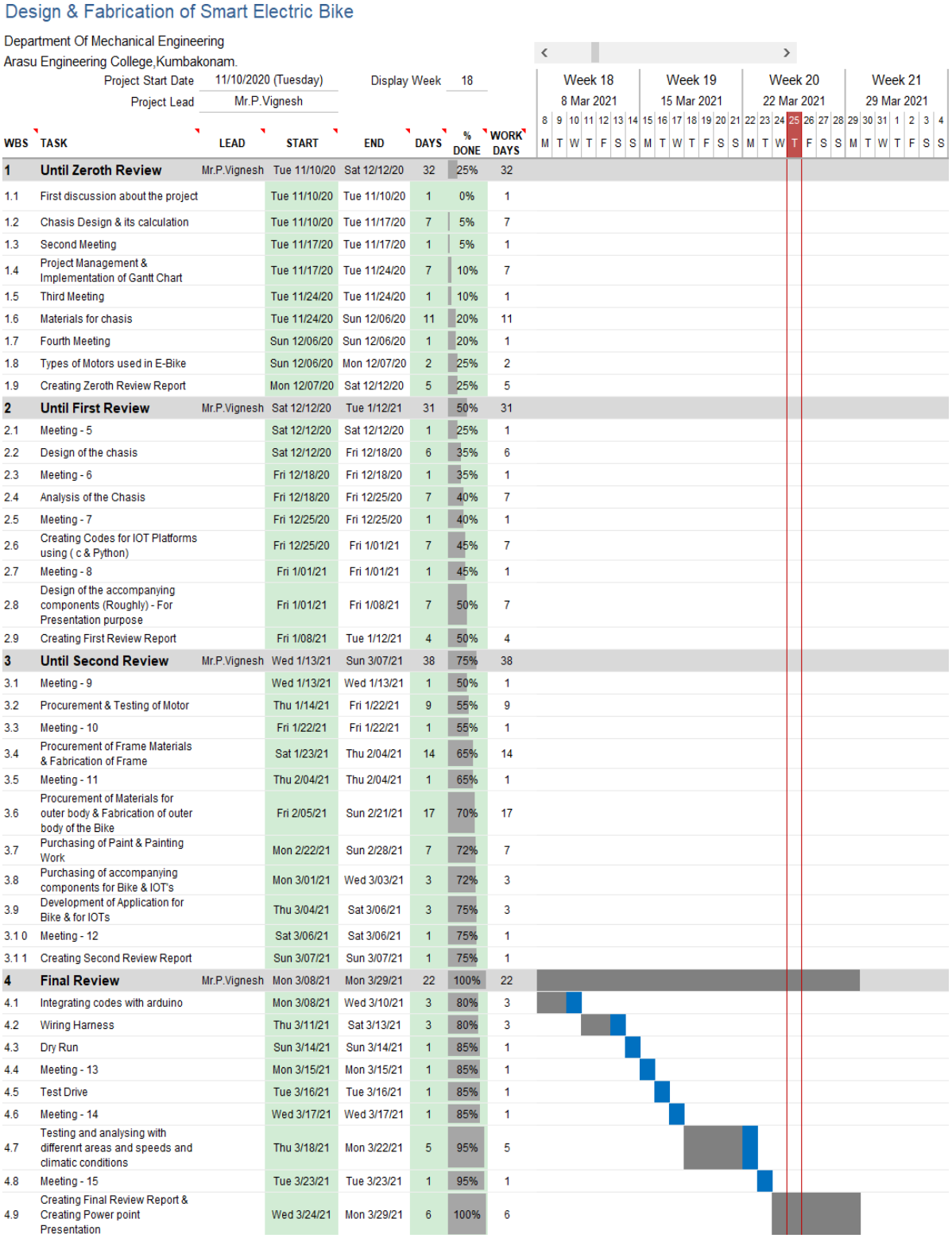
Design & Fabrication of Smart Electric Bike

Department Of Mechanical Engineering
Arasu Engineering College,Kumbakonam.

Project Start Date 11/10/2020 (Tuesday) Display Week 11
Project Lead Mr.P.Vignesh

WBS	TASK	LEAD	START	END	DAYS	% DONE	WORK DAYS
1	**Until Zeroth Review**	Mr.P.Vignesh	Tue 11/10/20	Sat 12/12/20	32	25%	32
1.1	First discussion about the project		Tue 11/10/20	Tue 11/10/20	1	0%	1
1.2	Chasis Design & its calculation		Tue 11/10/20	Tue 11/17/20	7	5%	7
1.3	Second Meeting		Tue 11/17/20	Tue 11/17/20	1	5%	1
1.4	Project Management & Implementation of Gantt Chart		Tue 11/17/20	Tue 11/24/20	7	10%	7
1.5	Third Meeting		Tue 11/24/20	Tue 11/24/20	1	10%	1
1.6	Materials for chasis		Tue 11/24/20	Sun 12/06/20	11	20%	11
1.7	Fourth Meeting		Sun 12/06/20	Sun 12/06/20	1	20%	1
1.8	Types of Motors used in E-Bike		Sun 12/06/20	Mon 12/07/20	2	25%	2
1.9	Creating Zeroth Review Report		Mon 12/07/20	Sat 12/12/20	5	25%	5
2	**Until First Review**	Mr.P.Vignesh	Sat 12/12/20	Tue 1/12/21	31	50%	31
2.1	Meeting - 5		Sat 12/12/20	Sat 12/12/20	1	25%	1
2.2	Design of the chasis		Sat 12/12/20	Fri 12/18/20	6	35%	6
2.3	Meeting - 6		Fri 12/18/20	Fri 12/18/20	1	35%	1
2.4	Analysis of the Chasis		Fri 12/18/20	Fri 12/25/20	7	40%	7
2.5	Meeting - 7		Fri 12/25/20	Fri 12/25/20	1	40%	1
2.6	Creating Codes for IOT Platforms using (c & Python)		Fri 12/25/20	Fri 1/01/21	7	45%	7
2.7	Meeting - 8		Fri 1/01/21	Fri 1/01/21	1	45%	1
2.8	Design of the accompanying components (Roughly) - For Presentation purpose		Fri 1/01/21	Fri 1/08/21	7	50%	7
2.9	Creating First Review Report		Fri 1/08/21	Tue 1/12/21	4	50%	4
3	**Until Second Review**	Mr.P.Vignesh	Wed 1/13/21	Sun 3/07/21	38	75%	38
3.1	Meeting - 9		Wed 1/13/21	Wed 1/13/21	1	50%	1
3.2	Procurement & Testing of Motor		Thu 1/14/21	Fri 1/22/21	9	55%	9
3.3	Meeting - 10		Fri 1/22/21	Fri 1/22/21	1	55%	1
3.4	Procurement of Frame Materials & Fabrication of Frame		Sat 1/23/21	Thu 2/04/21	14	65%	14
3.5	Meeting - 11		Thu 2/04/21	Thu 2/04/21	1	65%	1
3.6	Procurement of Materials for outer body & Fabrication of outer body of the Bike		Fri 2/05/21	Sun 2/21/21	17	70%	17
3.7	Purchasing of Paint & Painting Work		Mon 2/22/21	Sun 2/28/21	7	72%	7
3.8	Purchasing of accompanying components for Bike & IOT's		Mon 3/01/21	Wed 3/03/21	3	72%	3
3.9	Development of Application for Bike & for IOTs		Thu 3/04/21	Sat 3/06/21	3	75%	3
3.10	Meeting - 12		Sat 3/06/21	Sat 3/06/21	1	75%	1
3.11	Creating Second Review Report		Sun 3/07/21	Sun 3/07/21	1	75%	1

Figure 9 –Gantt chart until Second review



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1	**Until Zeroth Review**	Mr.P.Vignesh	Tue 11/10/20	Sat 12/12/20	32	25%	32
1.1	First discussion about the project		Tue 11/10/20	Tue 11/10/20	1	0%	1
1.2	Chasis Design & its calculation		Tue 11/10/20	Tue 11/17/20	7	5%	7
1.3	Second Meeting		Tue 11/17/20	Tue 11/17/20	1	5%	1
1.4	Project Management & Implementation of Gantt Chart		Tue 11/17/20	Tue 11/24/20	7	10%	7
1.5	Third Meeting		Tue 11/24/20	Tue 11/24/20	1	10%	1
1.6	Materials for chasis		Tue 11/24/20	Sun 12/06/20	11	20%	11
1.7	Fourth Meeting		Sun 12/06/20	Sun 12/06/20	1	20%	1
1.8	Types of Motors used in E-Bike		Sun 12/06/20	Mon 12/07/20	2	25%	2
1.9	Creating Zeroth Review Report		Mon 12/07/20	Sat 12/12/20	5	25%	5
2	**Until First Review**	Mr.P.Vignesh	Sat 12/12/20	Tue 1/12/21	31	50%	31
2.1	Meeting - 5		Sat 12/12/20	Sat 12/12/20	1	25%	1
2.2	Design of the chasis		Sat 12/12/20	Fri 12/18/20	6	35%	6
2.3	Meeting - 6		Fri 12/18/20	Fri 12/18/20	1	35%	1
2.4	Analysis of the Chasis		Fri 12/18/20	Fri 12/25/20	7	40%	7
2.5	Meeting - 7		Fri 12/25/20	Fri 12/25/20	1	40%	1
2.6	Creating Codes for IOT Platforms using (c & Python)		Fri 12/25/20	Fri 1/01/21	7	45%	7
2.7	Meeting - 8		Fri 1/01/21	Fri 1/01/21	1	45%	1
2.8	Design of the accompanying components (Roughly) - For Presentation purpose		Fri 1/01/21	Fri 1/08/21	7	50%	7
2.9	Creating First Review Report		Fri 1/08/21	Tue 1/12/21	4	50%	4
3	**Until Second Review**	Mr.P.Vignesh	Wed 1/13/21	Sun 3/07/21	38	75%	38
3.1	Meeting - 9		Wed 1/13/21	Wed 1/13/21	1	50%	1
3.2	Procurement & Testing of Motor		Thu 1/14/21	Fri 1/22/21	9	55%	9
3.3	Meeting - 10		Fri 1/22/21	Fri 1/22/21	1	55%	1
3.4	Procurement of Frame Materials & Fabrication of Frame		Sat 1/23/21	Thu 2/04/21	14	65%	14
3.5	Meeting - 11		Thu 2/04/21	Thu 2/04/21	1	65%	1
3.6	Procurement of Materials for outer body & Fabrication of outer body of the Bike		Fri 2/05/21	Sun 2/21/21	17	70%	17
3.7	Purchasing of Paint & Painting Work		Mon 2/22/21	Sun 2/28/21	7	72%	7
3.8	Purchasing of accompanying components for Bike & IOT's		Mon 3/01/21	Wed 3/03/21	3	72%	3
3.9	Development of Application for Bike & for IOTs		Thu 3/04/21	Sat 3/06/21	3	75%	3
3.10	Meeting - 12		Sat 3/06/21	Sat 3/06/21	1	75%	1
3.11	Creating Second Review Report		Sun 3/07/21	Sun 3/07/21	1	75%	1
4	**Final Review**	Mr.P.Vignesh	Mon 3/08/21	Mon 3/29/21	22	100%	22
4.1	Integrating codes with arduino		Mon 3/08/21	Wed 3/10/21	3	80%	3
4.2	Wiring Harness		Thu 3/11/21	Sat 3/13/21	3	80%	3
4.3	Dry Run		Sun 3/14/21	Sun 3/14/21	1	85%	1
4.4	Meeting - 13		Mon 3/15/21	Mon 3/15/21	1	85%	1
4.5	Test Drive		Tue 3/16/21	Tue 3/16/21	1	85%	1
4.6	Meeting - 14		Wed 3/17/21	Wed 3/17/21	1	85%	1
4.7	Testing and analysing with differenrt areas and speeds and climatic conditions		Thu 3/18/21	Mon 3/22/21	5	95%	5
4.8	Meeting - 15		Tue 3/23/21	Tue 3/23/21	1	95%	1
4.9	Creating Final Review Report & Creating Power point Presentation		Wed 3/24/21	Mon 3/29/21	6	100%	6

Figure 10 Gantt chart Until Final Review

Conclusion

Electric bikes are useful and can be used for short distance travelling. They can satisfy the travelling need within few km areas. Their speed can be regulated precisely. However, the present challenge is increment in mileage per unit charge of a battery so that they can be used for long distance travelling. Implementation of charging stations and more importantly fast charging of batteries without affecting their life span are some of the challenging tasks in E- vehicle implementations. The reliable design of converter is another important issue of focus. It is recommended to keep different controllers like for fault sensing and motor control. In case of any fault like component damage during runtime, the respective controller will interact with motor controller to take required action. This will also enhance the safety while travelling. Electric vehicles are the future of our world with the increasing consumption of non-renewable resources such as petroleum, diesel which leads us to

step our way towards the renewable sources such as solar hydro-electric power and battery. There are alternative ways by which we can save energy. One of such way is electric bike; it is also the new way of transport which provides us easy way of transport to provide of any age. It is cheap source of transport and affordable to anyone. The motor used in this bike has high efficiency and the battery bank has less weight with high speed. These bikes are environmental friendly, needs less maintenance and can be also assembled to small component.

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