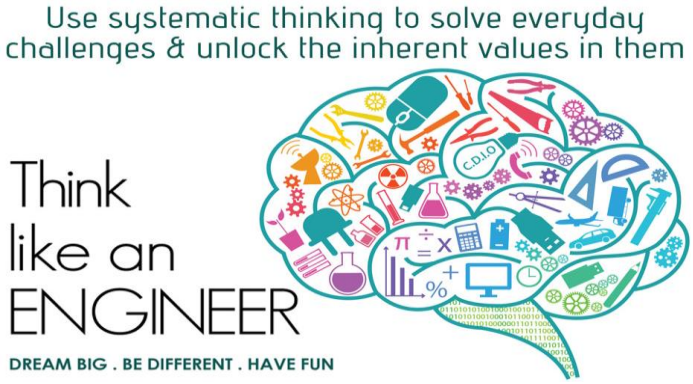
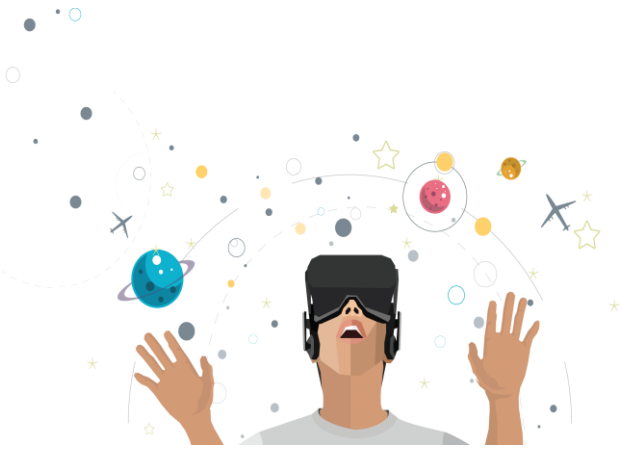
Half Yearly Magazine (Jun to Dec 2017)

RPTC TECHNICAL MAGAZINE

RANE TECHNO-VATE





LET'S TAKE THE FIRST STEP TO MAKE THE "SKILLFULL INDIA"...

.....

RANE POYTECHNIC TECHNICAL CAMPUS

From the Dean's Desk

Dear All,

Rane Polytechnic was conceived to be a "Centre of Excellence" amongst all polytechnics in this region. This desire that we move up the value chain would be possible only by small steps being taken in that direction by coming out with Technical papers, ensuring participation by students in Technical seminars and hosting a Technical Symposium of our own. I am happy to note that "RPTC Vaibhav" has received such great response with students participating from far and wide.

While on this, I also find that the variety of subjects in the various technical articles presented show the wide range of interests for all our staff members. The article on Fabrication of Voltaline bike is a topic of interest to all bike lovers. Advanced manufacturing system JIT, a time tested process practiced by Japanese industries is another. The Sixth sense device tells us about the all-pervasive Artificial Intelligence foray into motor vehicles.

Interesting reading and all the best.

RAJALAKSHMI .B. M.S., AICWA
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MECHANICAL ENGINEERING

1. Design and Fabrication of Voltaline Bike(Dual Mode Power Drive)

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In automobile sector, the need for alternative fuel replacement of conventional fossils fuels, due to its depletion and amount of emission has given way for new technologies like Electric vehicle, Natural Gas Powered vehicle,. etc. Still lot of advancement has to place to in these technologies for commercialization. The gap between the current fossils fuels technology and zero emission vehicles can be bridged by hybrid technology. This technology maximize the advantage of the two fuels and minimize the disadvantages of the same. In this project our hybrid bike delivers the power both via an Internal Combustion Engine and Electric Motor .The Electrical powered is used to achieve either better Fuel Economy than a Conventional vehicle, better performance, and it cause less pollution. Driving mode selectivity improves this system more economical, stable and efficient. The hybrid systems have long been existed and they are not a new technology. The hybrid system are strong enough to suggest that is much advanced than a conventional vehicle and it is highly beneficial to our environment.

- ***Keywords:*** *Hybrid Bike, Electric Motor, Heat Engines, Combustion Engine, Solar-cell*

INTRODUCTION

Around 93% of today's automobiles run on petroleum based product, which are estimated to be depleted by 2050. Moreover, current automobiles utilize only 25% of the energy released from petroleum and rest is wasted into the atmosphere. Despite recent efforts to improve fuel efficiency and reduce toxic emissions in cars, emissions have continued to increase steadily in the past two decades. An electric vehicle is pollution free and is efficient at low speed conditions mainly in high traffic areas. But battery charging is time consuming. Moreover, it cannot provide high power required by drives during high speed conditions or in slopes of hilly areas. Gasoline engine proves its efficiency at higher speeds in high ways and waste a lot of energy in urban areas. A hybrid vehicle solves these problems by combining the advantages of both the systems and uses both the power sources at their efficient conditions. The objective of this project aims at better utilization of fuel energy and reduces dependence on non-renewable resources using hybrid technology. The implementation involves development of voltaline bike (Dual mode power drive) that uses battery as well as gasoline power for propulsion of vehicle.

A Voltaline Bike is an automobile which relies not only on gasoline but also on electric power source. In Voltaline bike, the battery alone provides power for low-speed driving conditions. During long highways or hill climbing, the gasoline engine drives the vehicle solely. Voltaline bike comprise of an electric motor, battery as electric drive and an internal combustion engine with transmission connected as gasoline based drive. It is to achieve better fuel economy and reduce toxic emissions. It has great advantages over the previously used gasoline engine that is driven solely from gasoline. This hybrid combination makes the vehicle dynamic in nature and provides its owner a better fuel economy and lesser environmental impact over conventional automobiles.

This design consists of a dc power source battery. The battery is connected to the controller and that is connecting to a HUB motor that works on DC. The hub motor is attached in both the front and back of the wheels in the two wheeler vehicle. As the *motor rotates the attached wheel rotates too, thus, leading to vehicle motion. At low speeds this mode of propulsion is used. The next phase consists of an IC engine that moves the piston continuously.*

LITERATURE REVIEW

- *Darshil G. Kothari, Jaydip C. Patel, Bhavik R. Panchal[1].The term "hybrid" usually implies that more than one energy source is used to power all or part of a vehicle's Rechargeable battery is used with long life for charging. DC electric motor is also used in this project. The hybrid bicycle is a project that can promote both cleaner technology as well as a lesser dependence on oil. It will run on clean electric power with the ability to recharge the battery 3 separate ways: through the charger, by generating power through the pedals of the bicycle, and by solar-cell generative power.*

- *Arun Eldho Alias1, Geo Mathew2, Manu G3, Melvin Thomas4, Praveen V Paul5[2]. Hybrid vehicles are those which can run on two or more powering sources fuels. This technology maximizes the advantages of the two fuels and minimizes the disadvantages of the same. The best preferred hybrid pair is electric and fossil fuel. Driving mode selectivity improves this system more economical, stable and more efficient.*

- *Zhidong Zhang [3]. a design of brushless DC motor controller strategy applied to the electric bicycle control system was presented in the paper. Function of over-current protection, under-voltage protection and helping were accomplished. Schematic diagrams of each function and drive circuit*

were given in the paper, the controller was debugged in rated voltage 36V and power rating. 250W brushless DC motor, experiment turned out controller has better dynamic characteristics and ran steadily.

- *Said Mahmut Çinar, Fatih Onur Hocaoğlu [4]. In this paper joint performances of two hub motors that are designed for electrical motorcycles are investigated.*

- *Nicolo Daina, Aruna Sivakumar., John W. Polak [5] This paper provides a systematic review of these diverse approaches using a twofold classification of electric vehicle use representation, based on the time scale and on substantive differences in the modeling techniques.*

CONVENTIONAL VEHICLE

An engine is a device that transforms one form of energy to another and if an engine converts thermal energy to mechanical works, it is called as heat engines. A heat engine converts the stored chemical energy of the fuels to thermal energy and finally this thermal energy is converted to mechanical work. A throttle valve controls the volume of the air that needs to be drawn. Air cooled system:

Transmission system in conventional mode

In this, a current of air is made to flow past the outside of the cylinder barrel, outside surface area of which has been considerably increased by providing cooling fins. The heat transfer rate is quiet low between metal and air, thus suitable for lightweight engines. Cooling fins are cast integral with the cylinder and cylinder head to obtain maximum heat transfer.

ELECRICAL DRIVING MODE

The underlying principles for the working of a BLDC motor are the same as for a brushed DC motor; i.e., internal shaft position feedback. Most BLDC motors have three Hall sensors embedded in the stator on the non-driving end of the motor. Whenever the rotor magnetic poles pass near the Hall sensors, they generate a high or low signal, which indicates that N or S pole is passing near the sensors. Based on the combination of these Hall Sensor signals, the exact sequence of commutation can be determined. In case of a brushed DC motor, feedback is implemented using a mechanical commutator and brushes. The most commonly used sensors are hall sensors and optical encoders.

Electrical mode driving

ELECTRICAL COMPONENTS

- *Motor*
- *Battery*
- *Controller*
- *Throttle position sensor*

MOTOR

Motor is made up of skillful wrapping of coils on a stator, a rotor for the rotation, and magnets to influence the rotations. The magnets used their work Electro magnetically. That means electricity influences this iron to behave like a magnet, having both attraction and repulsion characteristics of a magnet into this, thereby helping it to generate the motion accompanying this. The principle in this is to switch the direction of the forces to keep the motor to move continuously, once it is started until the time it is stopped. There are two types of motors commonly used in e-bikes, one is brushed motor and another is

brushless.

TYPES OF DC MOTOR

1.BRUSHED VS BRUSHLESS HUB MOTORS

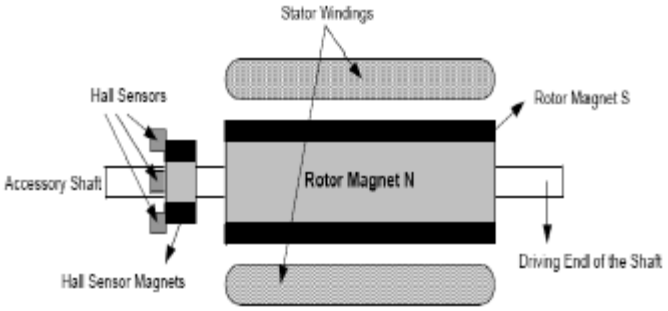
Modern e-bikes all prefer to use "brushless" hub motors, just because they are more durable than its "brushed" counterpart, besides the maintenance cost in them is also very little. Limited in quantity making them expensive comparatively. But in the long run they seem to be lot reliable. Both by the cost and performance. They function little differently again as are described here below.

2.BRUSHED HUB MOTORS

In a brushed hub motor, small metal "brushes" which transfers electrical energy to the commuter, a rotating part of the motor. This replacement is not so expensive but to manage this work itself is not so easy.

3.BRUSHLESS HUB MOTORS

In a brushless motor, as there is no physical contact from any parts of the motor inside, therefore there is virtually no wear and tear possibilities, making the motor's durability limitless. These motors have more sophisticated controllers, and it makes it possible for using three different windings, and power is supplied individual Windings according to the position they are in the movement. When the motor passes one winding, the controller passes the power to another winding, making the movement to continue without stopping. These types of motors are quite popular nowadays.



Construction of BLDC Motor

SPECIFICATIONS FOR BLDC MOTOR CONTROLLER

SL No	Particulars	Specifications
1	Rated Capacity	30KW
2	Input Voltage	36 - 48V DC
3	Rated Current (Max.)	15 Amp
4	Starting current	Not exceeding 2 times of nominal Current
5	Over current Limit	20% of nominal
6	Speed Range	300 RPM(±10%)
7	Overvoltage Limit	10% of nominal voltage.
8	Motor feedback	Hall effect sensors
9	Commutation	Trapezoidal
10	Mode of operation	Velocity mode(closed loop control)
11	Input signals	Run/Stop Emergency stop.
12	Display/Indications	LCD display for voltage, current, Frequency& speed.
13	Operating temp./Humidity	0 - 55°C/ 95(+/-3%)
14	Approx Size	≤ 500 x 150 (D x W) in mm
15	Cooling for Inverter	Heat pipe to make controller Compact

ADVANTAGES OF BLDC MOTOR:

- *High Speed Operation – A BLDC motor can operate at speeds above 10,000 rpm under loaded and unloaded conditions.*
- *Responsiveness & Quick Acceleration – Inner rotor Brushless DC motors have low rotor inertia, allowing them to accelerate, decelerate, and reverse direction quickly.*
- *It has no mechanical commutator and associated problems*
- *High efficiency due to the use of permanent magnet rotor*

BATTERY

Batteries operate by converting chemical energy into electrical energy through electrochemical discharge reactions. Batteries are composed of one or more cells, each containing a positive electrode, negative electrode, separator, and electrolyte. Cells can be divided into two major classes: primary and secondary.

TYPES OF BATTERY

Primary cells are not rechargeable and must be replaced once the reactants are depleted. Examples of primary cells include carbon-zinc (Leclanche or dry cell), alkaline-manganese, mercury zinc, silver-zinc, and lithium cells (e.g., lithium-manganese dioxide, lithium-sulfur dioxide, and lithium chloride). Secondary cells are rechargeable and require a DC charging source to restore reactants to their fully charged state. Examples of secondary cells include lead-lead dioxide (lead-acid), nickel-cadmium, nickel-iron, nickel-hydrogen, nickel-metal hydride, silver-zinc, silver-cadmium, and lithium-ion.

Batteries are rated in terms of their nominal voltage and ampere-hour capacity. The voltage rating is based on the number of cells connected in series and the nominal voltage of each cell (2.0 V for lead acid and 1.2 V for nickel-cadmium). 12-volt lead-acid batteries, consisting of six cells in series, are also used in much general purpose. The ampere-hour (Ah) capacity available from a

fully charged battery depends on its temperature, rate of discharge, and age. Normally, batteries are rated at room temperature (25°C), the C-rate (1-hour rate), and beginning of life.

Electrochemistry Cell	Voltage
Lead-Acid	2.0
Nickel-Cadmium	1.2
Nickel-metal hybride	1.2
Lithium-ion	3.4
Lithium-polymer	3.0
Zinc-air	1.2

Average Cell Voltage during Discharge in various Rechargeable batteries

LEAD-ACID BATTERIES

Lead-acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities. Large-format lead-acid designs are widely used for storage in backup power supplies in cell phone towers, high-availability settings like hospitals, and stand-alone power systems. ***Gel-cells*** *and* ***absorbed glass-mat*** *batteries are common in these roles, collectively known as VRLA.*

BATTERY SPECIFICATION

- *Nominal voltage (v) 12v*
- *20 hour rate (0.25 a to 10.50v) 5ah*
- *10 hour rate (0.475 a to 10.50v) 4.75ah*
- *5 hour rate (0.85 a to 10.20v) 4.25ah*
- *1c (5a to 9.60v) 2.833ah*
- *3c (15a to 9.60v) 2.0ah*

- *Weight approx. 4.18lbs. (1.9kg)*

Battery

CONTROL KIT

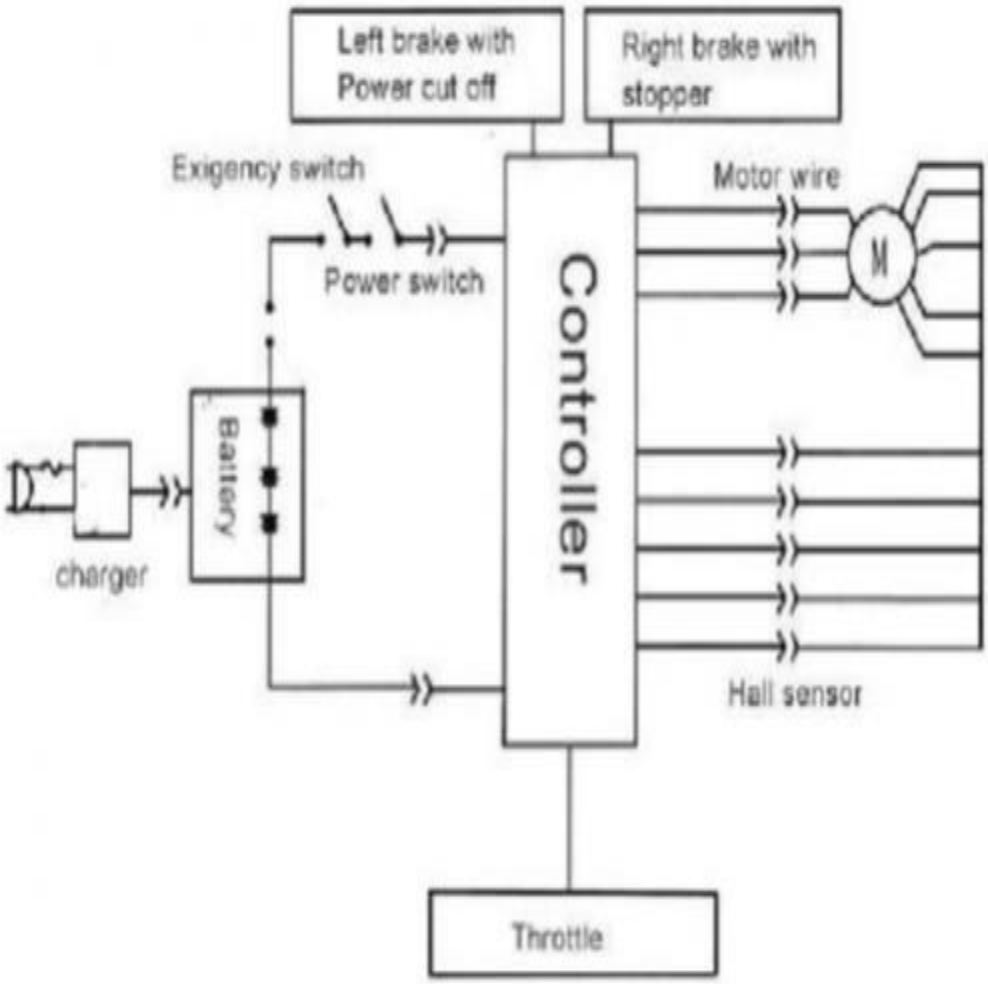
There are mainly two types of controllers which are designed to be effective on two types of motor, one is brushed, and another is brushless. According to the motor in use the controller function also varies. Brushless motors are popular nowadays because of high efficiency and durability, and it is also supported by the reduced cost factors, whereas brushed motors because of less complex controller mechanism, is still in use fairly.

controller

CONTROLLERS USED IN BRUSHLESS MOTORS

There are various sensors used to check and control the speed movements. To do this quite efficiently, Hall sensor is used. The reason is also that e-bike requires strong initial torque to complement the low powered motor, this mechanism to control with safe the speed, the sensor has special functions to monitor the speed accurately. Various electronic controllers provide real time

data input to the controller to react according to the situation. The controllers work with closed-loop speed control mechanism for precise speed control, by adjusting the speed and also over-voltage surge, over-current input, or other levels of protections. Controller uses PWM (pulse width modulation) to adjust the power input to motor



Controller Circuit

THROTTLE POSITION SENSOR

A throttle position sensor is a sensor used to monitor the position of the throttle in an internal combustion engine. It consists of hall sensor .when the accelerator throttle angle 13 magnetic field is created and it creates voltage Across position sensor terminal. The battery connect to the control kit then the control kit connect to parallel connection in throttle and motor.so throttle adjust the angle the various speed obtain in the motor.

HYBRID VEHICLE

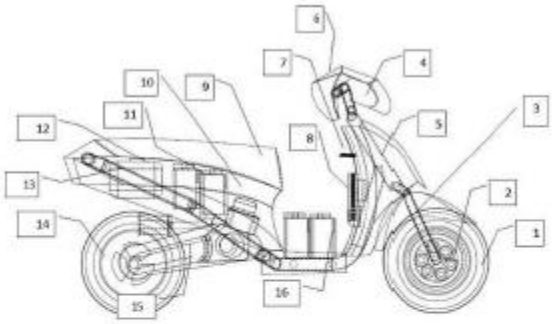
A hybrid vehicle uses two or more distinct types of power, such as internal combustion engine plus electric motor. e.g. in petrol-electric trains using petrol engines and electricity from overhead lines, and submarines that use petrol when surfaced and batteries when submerged. Other means to store energy include pressurized fluid in hydraulic hybrids. The project discloses a hybrid system consisting of an Electric and Internal Combustion(IC) based power drives. The front wheel is being propelled by battery and the rear wheel is powered by propelled by battery and gasoline, i.e, it includes a single cylinder, air cooled internal combustion engine and a BLDC motor based electric power drive used for hybrid powering of the vehicle. The controller is designed to implement the switching between IC Engine and Electric motor depending on the power requirement and load conditions.

CAD MODEL OF VOLTALINE BIKE:

Rendered View

Front Rendered View

Side Rendered View



Wire frame model

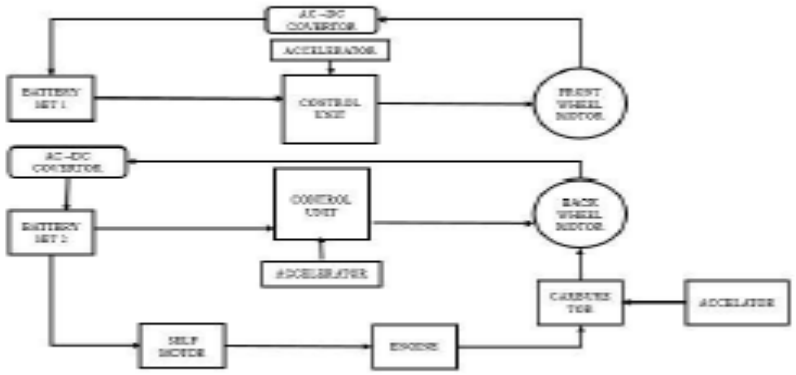
1) Tyre 2)Hub Motor 3)Suspension 4)Headlamp

5) Body Cover 6) Display 7)Microcontroller 8)Controller 9) Seat 10) Engine 11) front battery set

12) Fuel Tank 13) 13)Chassis 14) Rear Tyre

15) Transmission 16) Rear Battery

BLOCK DIAGRAM



Voltaline bike

WORKING PRICIPLE

In Voltaline bike the battery alone provide power for low speed driving condition, where the internal combustion engines are least efficient. In the Voltaline bike system consist of battery set 1 and 2(a set consists of 4 battery each one 12 volts).it has one internal combustion engine with transmission system. and it has ,two e-bike wheel(hub motor) one in the front and another one in the rear side.so, this Voltaline bike offers three mode driving selectivity system.

CONVENTIONAL DRIVING SYSTEM:

In the conventional mode the engine that works on the basic principle and transmit the power through transmission system of the wheel to move the vehicle.

ELECTRICAL DRIVING SYSTEM:

- ✓ *Front wheel electrical drive system*
- ✓ *Rear wheel driving system*

1) Front Wheel Electrical Drive System

In this electrical driving mode the vehicle is running in the front hub motor. The battery set 1 is provide power to drive the vehicle. At the same time the rear

hub motor generate the power and stored in the battery set 2.

2) Rear Wheel Electrical Drive System

In this electrical driving mode the vehicle is running in the rear hub motor. The battery set 2 is provide power to drive the vehicle. At the same time the front hub motor generate the power and stored in the battery set1. Thus the charging and discharging are repeated in cyclic based on driving mode selection. In the conventional system both front and rear hub motors are act as a power generator and it is stored in battery set 1 and 2 respectively.

EXPERIMENT RESULT

1. ANALYSIS

During combustion of gasoline, high temperature gases are generated which increase the temperature of the cylinder head. A long, conductive radiating fins are casted with the cylinder head to remove the heat from the interior to the environment. High temperature affects the performance of the engine, combustion of the lubricating oil is a serious problem which needs to be taken care of. the temperature distribution of the cylinder head when the vehicle is running at higher speeds and heat transfer is mainly through convection. The simulation is colour coded which depicts that red colour shows higher temperature and blue colour shows the region of lower temperature. the heat flux distribution in a cylinder head. Fig (a) shows the stress analysis of the the chassis.

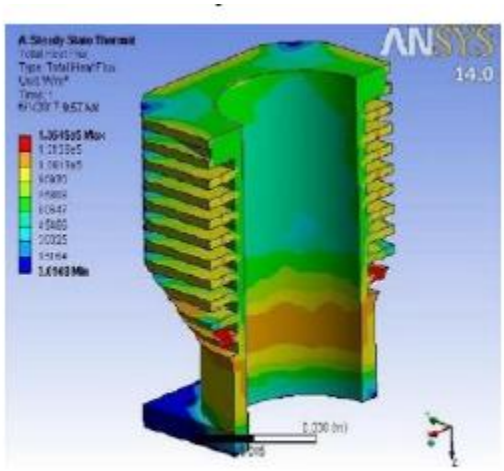


Fig .temperature analysis for engine

The bluish portions experience less stress and the reddish portions have more stress. The chassis portion with red in colour is to be made with proper care The square wave produced is fed to the BLDC motor for maximum efficiency. Fig the variation of torque, speed, output voltage and armature current with time of the electric drive.

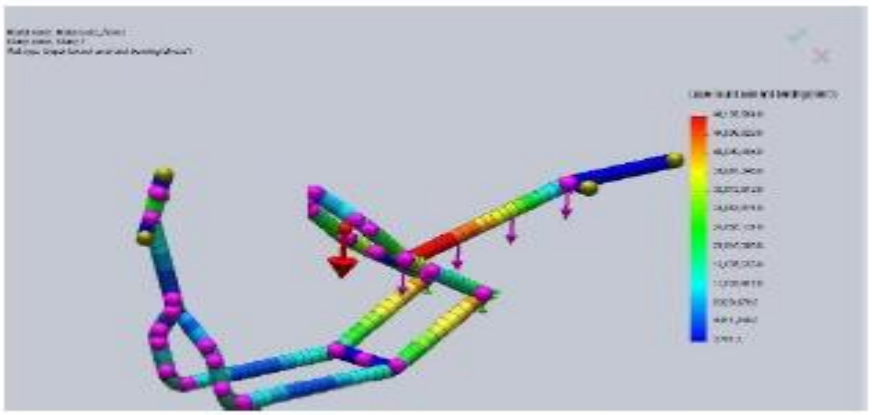


Fig Stress analysis of chassis

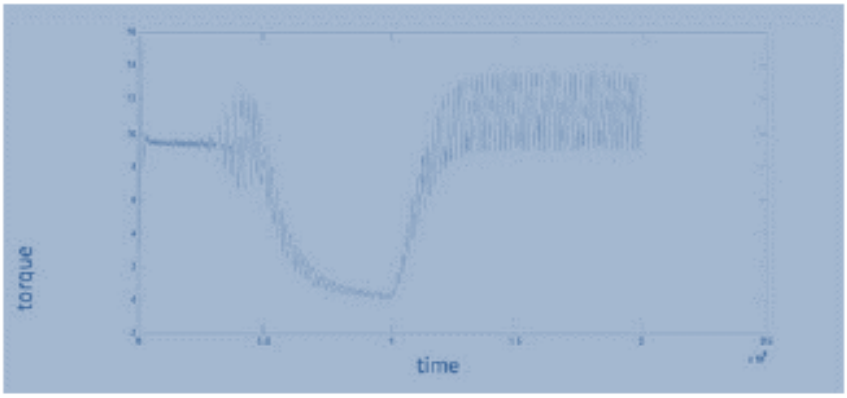
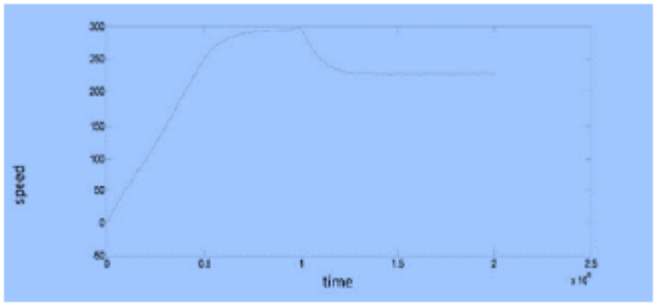
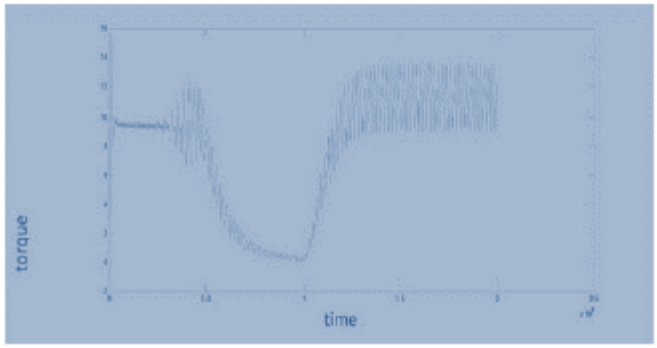


Fig Output torque of BLDC motor at no load



Speed of BLDC motor at no load



Output torque of BLDC motor at no load

CALCULATIONS

DETERMINATION OF TORQUE OF TWO WHEELER:

N=550rpm

Power of Vehicle= 2.68 KW,

$P=\frac{2\pi NT}{60}$

$T=\frac{2684*60}{2*\pi*550}$

T=46.609NM @ 550 Rpm

Hence the minimum torque of the vehicle is 46.609Nm. @ 550 rpm.

CALCULATION FOR TOTAL POWER OF ELECTRIC VEHICLE.

TOTAL POWER:

$P_{TOTAL} = P_{DRG} + P_{RC} + P_{SLOPE}$

POWER LOSS DUE TO DRAG FORCE.

$$P_{DRAG} = \frac{Cd * A * \rho * v^3}{2}$$

C_d = Drag coefficient = 1

A =area of the vehicle and rider.

A (Upright rider) = 0.6 m^2 and A(Crouched rider) = 0.4 m^2, ρ =Density of Air = 0.4 kg/m^3

v = velocity = 6.95 m/s.

$$P_{DRAG} = \frac{1*0.6*0.4*6.95^3}{2}$$

P_{DRAG} = 40.2842 (upright skater). $P_{DRAG} = \frac{1*0.4*0.4*6.95^3}{2}$

P_{DRAG} = 18.7993 (crouched skater)

POWER LOSS DUE TO DRAG FORCE	CROUCHED RIDER	UPRIGHT RIDER
	18.7993	40.2842

power loss due to drag force

P_{RC} = 12.4086 (flat surface)

P_{RC} = g * m * R_C * v

Let R_C = 0.004 for the instant stony surface,

g = acceleration due to gravity = 9.81 m/s,

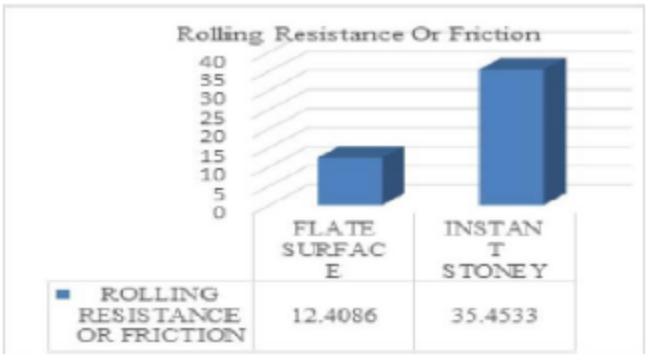
Velocity (v) = 6.95 m/s, and mass (m) = 130 kg.

P_{RC} = 9.81*130*0.004*6.95

P_{RC} =35.4533(instant stony surface)

ROLLING RESISTANCE OR FRICTION	FLATE SURFACE	INSTANT STONEY
	12.4086	35.4533

Table 7 power loss due to rolling resistance



power loss due to resistnce

POWER LOSS AT SLOPE OR HILL

$$P_{slope} = \frac{g*m*v*\propto}{100}$$

Let g = acceleration due to gravity = 9.81 m/s,

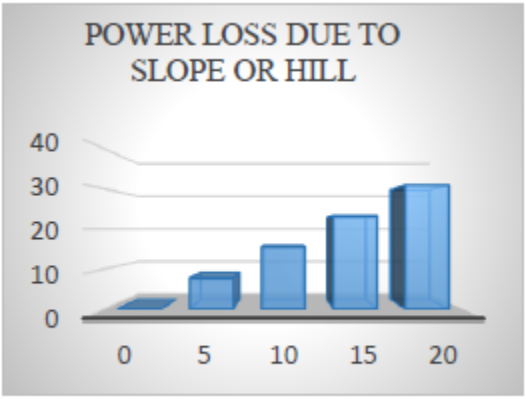
Velocity (v) = 6.95 m/s,
and mass (m) = 130 kg, α = angle of slope or hill in radians.
If the $\alpha = 0^o$ then the $P_{slope} = 0$
the $\alpha = 5^o$

$$P_{slope} = \frac{9.81*130*6.95*0.0872}{100}$$

P_{slope} =7.7288
If the $\alpha = 10^o$ then the $P_{slope} = 23.1953$
If the $\alpha = 15^o$ then the $P_{slope} = 23.1953$
If the $\alpha = 20^o$ then the $P_{slope} = 30.9330$

POWER LOSS DUE TO SLOPE OR HILL	ANGLE in Degree	0	5	10	15	20
	P(slope)	0	7.72	15.46	23.19	30.93

power loss due to slope



power loss due to slope

TOTAL POWER

$$P_{TOTAL} = P_{DRG} + P_{RC} + P_{SLOPE}$$

Drag power		Power loss on Rolling Resistance		Power loss on slope		Total power
upright rider	40.284	flat surface	12.4086	0	0	52.69
				5	7.728	60.4
				10	15.4665	68.15
				15	23.19	75.8
				20	30.93	83.6
		stony surface	35.4533	0	0	75.73
				5	7.7288	83.46
				10	15.4665	91.19
				15	23.1953	98.93
				20	30.9330	106.66
crouched rider	18.799	flat surface	12.4086	0	0	31.2
				5	7.7288	38.92
				10	15.4665	46.67
				15	23.1953	54.39
				20	30.93	62.1
		stony surface	35.4533	0	0	54.2
				5	7.728	61.9
				10	15.4665	69.71
				15	23.1953	77.44
				20	30.9330	85.18

total power loss

Total power loss

CONCLUSION

Voltaline is a vehicle that uses two sources of power from ICE and battery. For low power application battery drive is used whereas for high power application where power requirement is very high gasoline engine is used. Gasoline drive is most efficient at high speed drive. Thus Voltaline's both mode of operation occurs at their maximum efficiency. But in gasoline engine low speed operation is not efficient. Its high speed mode is only efficient. Therefore, it gives twice the mileage given by a normal vehicle. As this hybrid vehicle emits 50% less emission than normal vehicle it plays an important role for reducing pollution to certain extent without compromising with efficiency. Thus it is most efficient in urban areas mainly in high traffic where gasoline engines are least efficient as the energy from gasoline is being wasted away and creates pollution. Then this concept are generate the power in repeated. The sychronization between the electrical motor and internal combustion engine propulsion leads to less petrol consumption can be seen with charging cycle of batteries. If one vehicle can save an average of about 30% of petrol, then average of about 40 -60 % of national fuel can be conserved in this type of vehicle. The algorithms can be developed in synchronizing the electric motor and internal combustion engine turning on and off periods releventaly depending upon the driving cycle, so fuel efficency of the vehicle can be much improved. The Repeated regeneration process will surely helps the consumer to drive the vehicle in electrically and it will bridges towards the zero emission Environment. The batteries used in this vehicle will get in to recycle after they lose the capacity to store the power.

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2.ADVANCED MANUFACTURING SYSTEM(JUST IN TIME MANUFACTURING)

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INTRODUCTION

Just-In-Time (JIT) manufacturing has been implemented successfully in Japan for the past 20 years. It is a philosophy as well as a technique that guides a manufacturing company in organizing and managing its business more effectively, and in planning and controlling its operations more efficiently. It is a way to achieve high velocity manufacturing. ***Just-in-time*** *(****JIT****)* ***manufacturing****, also known as* ***just-in-time production*** *or the Toyota Production System (TPS), is a methodology aimed primarily at reducing times within production system as well as response times from suppliers and to customers. Its origin and development was in Japan, largely in the 1960s and 1970s and particularly at Toyota. Just-in-time (JIT) manufacturing is a production model in which items are created to meet demand, not created in surplus or in advance of need. The purpose of JIT production is to avoid the waste associated with overproduction, waiting and excess inventory, three of the seven wastes categories defined in the Toyota Production System .****High Velocity Manufacturing***

Traditionally, a manufacturing business competes on price, quality, variety, after service, etc. Now, these conditions are merely prerequisites. Few businesses exist today without offering low prices, high quality, and good service. The key competitive factor has become speed. All else being equal, the faster a business responds to its customers, the more profitable it is. The shorter

the lead-time in which a manufacturer can supply its products, the higher the probability that it will survive. High velocity manufacturing is a common goal for all manufacturing businesses. In high velocity manufacturing, everything is moving. Machines, people, funds and materials are constantly moving. Therefore, inventories in storage or on the shop floor are moving inventories rather than sitting inventories. Inventories are stocked only for a very short time, and will move to other locations only moments after being stocked. The conditions of high velocity manufacturing include flow manufacturing, line balancing, level schedule, and linearity.

1.Flow Manufacturing

A product or a group of similar products are processed through a series of workstations arranged in a fixed sequence. The materials flow through each workstation at a constant production rate.

2.Line balancing

Line balancing is required in high velocity manufacturing. Under this condition, tasks must be designed so that the work assigned to each workstation will require about the same amount of time to complete. There is no bottleneck and no buildup of work-in-process (WIP) inventories. For cases where bottlenecks are unavoidable, the theory of constraints (TOC) is applied. TOC will be discussed later.

3.Level Schedule

The schedule sets the flow of material coming into and passing through the manufacturing system. Since the flow of materials must be even in a high velocity manufacturing system, the schedules are designed to be level.

4.Linearity

Linearity refers to production at a constant rate or the use of resources at a level rate that is measured at least
daily

Seven waste

- *Waste of stock*
- *Waste of waiting*
- *Waste of processing*
- *Waste of defection production*
- *Waste of over production*
- *Waste of motion*
- *Waste of transportation*

Objective of JIT

JIT Manufacturing tries to smooth the flow of materials from the suppliers to the customers, thereby increasing the speed of the manufacturing process. The objectives of JIT are to change the manufacturing system gradually rather than drastically:

1. *To be more responsive to customers,*
2. *To have better communication among departments and suppliers,*
3. *To be more flexible,*
4. *To achieve better quality,*
5. *To reduce product cost.*

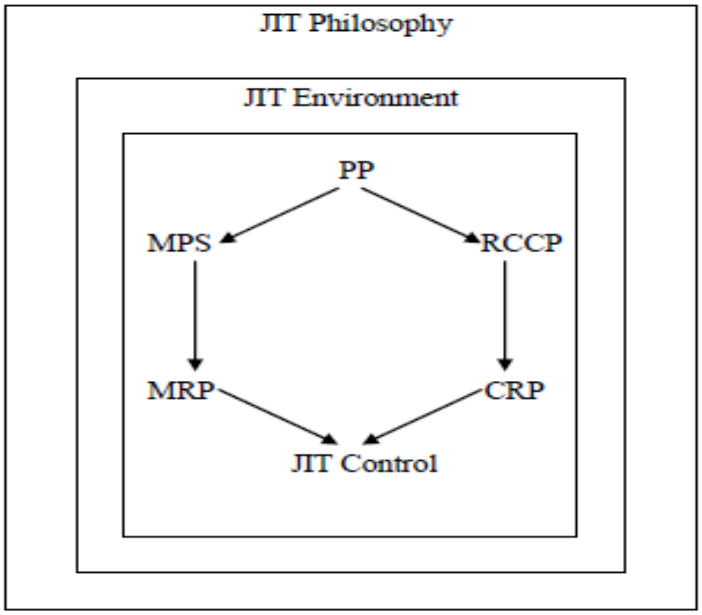
JIT WORK

The simplest tool used to increase the performance of your application is the ***Just-In-Time*** *(****JIT****) compiler. A* ***JIT*** *is a code generator that converts Java bytecode into native machine code. Java programs invoked with a* ***JIT*** *generally run much faster than when the bytecode is executed by the interpreter.*

JIT Concept

The operations planning and control system is an information system running throughout the manufacturing environment. For example, dedicated special facilities are used in make-to-stock environments; general purpose machines are used in make-to-order environments. Dedicated production lines can be designed in a balanced way with minimal setups in order to maximize the flow rate of the materials, while a general purpose machine must be set up before producing a specific item. In setup operations, the material flow is interrupted. Manufacturing environments can be changed to make planning and control systems simpler and more effective. For example, products are designed to have high similarity in processing and are mixed in a dedicated production

line with negligible setups. Since lead-times are shortened, this turns a make-to-stock product into a make-to-order product. Just-in-time is not only a control technique, but also a way to improve the manufacturing environment. JIT control systems are only effective in JIT environments. Introducing kanban systems into a non-JIT environment means nothing to a company. JIT Control can be incorporated into an ERP system as a control part with a condition that the system has to be in a JIT environment. The JIT philosophy guides the development of the JIT environment. The JIT environment provides the foundation for implementing the JIT control techniques.



JIT Concept

Different Types of JIT

There are different types of JIT

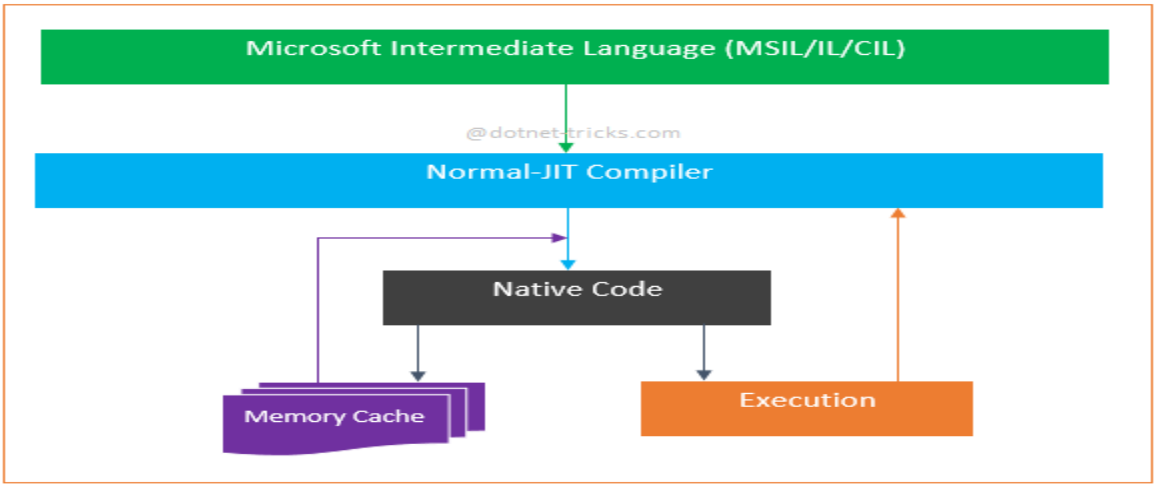
1.Normal JIT

2.Econo JIT

3.Pre JIT

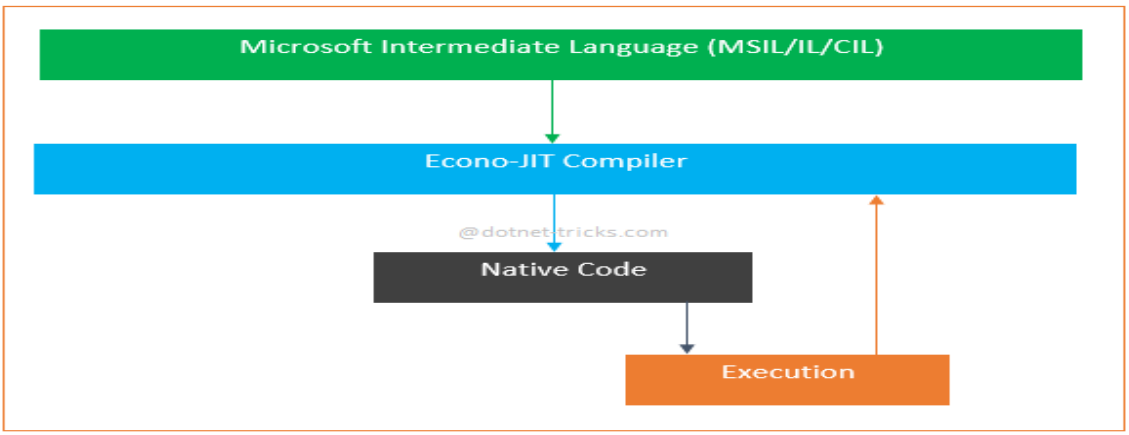
Normal JIT

This complies only those methods that are called at runtime. These methods are compiled only first time when they are called, and then they are stored in memory cache. This memory cache is commonly called as JITTED. When the same methods are called again, the complied code from cache is used for execution.



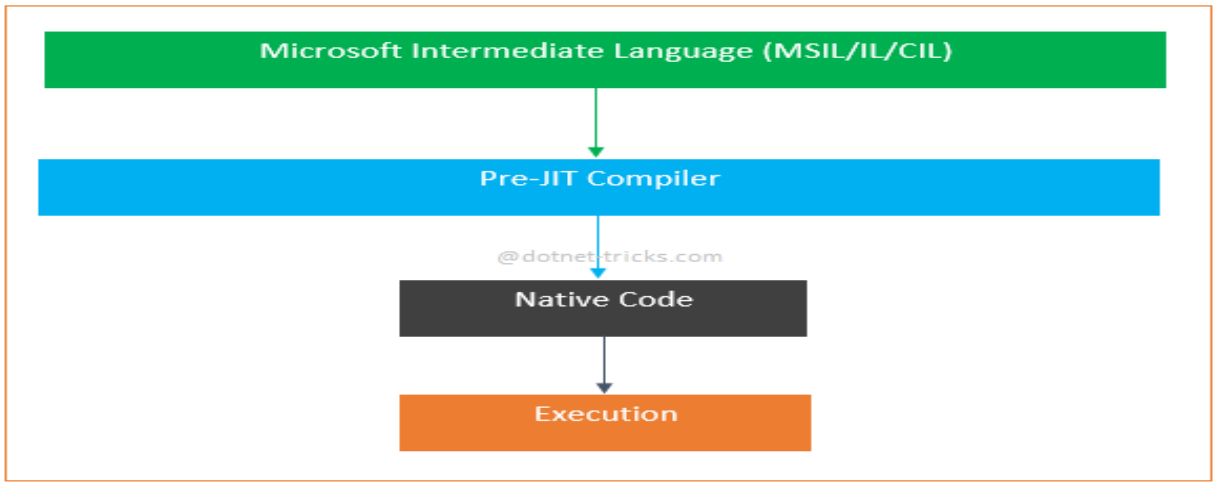
Econo JIT

This complies only those methods that are called at runtime and removes them from memory after execution.



Pre JIT

This complies entire MSIL code into native code in a single compilation cycle. This is done at the time of deployment of the application.



JIT as a Philosophy

Elimination of waste

Any activity that does not add value to the product or service in the eyes of the customer is a waste. Poor product design such as the inclusion of fancy functions not required by the customer is a waste. A product design causing difficulty in manufacturing is a waste. Standardization reduces the planning and control efforts, the number of parts, and the inventory required. A poor product design without enough standardization leads to waste. In addition to waste resulting from poor design, Toyota identifies seven examples of waste resulting from poor manufacturing methods below.

1. *Waste of overproduction*
2. *Waste of waiting*
3. *Waste of movement*
4. *Waste of inventories*
5. *Waste of motion*

6. *Waste of making defects*
7. *Waste of process itself*

1. Waste of overproduction

Overproduction is the production of goods more than what are immediately Just-In-Time Manufacturing needed. Overproduction causes extra material handling, quality problems, and unnecessary inventories. Consuming materials for unnecessary products may cause a shortage of material for other products that are needed. Never overproduce products to keep men and machines busy. If the required loading is less than the capacity, leave it alone. The labor can be switched to other departments, cleaning or maintaining the machines, accepting training and education, etc.

2. Waste of waiting

A material waiting in queue is a waste. An operator waiting for material or instruction and having no productive work to do is a waste.

3. Waste of movement

Poor plant layout results in materials having to be moved extra distances and cause unnecessary material handling costs. Work centers should be close to each other in order to reduce the move distance. Someone may say that close work centers provide no room for WIP inventories. That is fine! No room for WIP inventory forces the WIP to decrease.

4. Waste of inventories

Inventory causes costs of interest, space, record keeping, and obsolescence. Moreover, inventory can mask problems which could cause more inventory buildup. For example, WIP inventory between work centers can hide the symptoms of an unbalanced production rate. Finished goods inventory can mask poor forecasting, poor quality, and poor production control. Inventory is not an asset; it is a waste!

5. Waste of motion

Improper methods of performing tasks by the operators cause wasted motions. Reaching far for materials or machine buttons is a waste of motion. Searching for tools is a waste of motion. Any activity that does not add value to the products should be eliminated. Bad layout or training causes waste of motion. Just-In-Time Manufacturing

6. Waste of making defects

The cost of scraps is a waste. But it is the least important compared with other wastes caused by making defects. Defects interrupt the smooth flow of materials in the production line. If the scrap is not identified, next workstation will try using it to produce more wastes, or waste time waiting for good materials.

7. Waste of process itself

Bad process design is a waste. For example, wrong type or size of machines, wrong tools, and wrong fixtures are wastes.

The principle of eliminating the wastes includes:

1. All waste should be eliminated.

2. Waste can gradually be eliminated by removing small amounts of inventory from the system, correcting the problems that ensue, and then, removing more inventory.

3. The customers' definitions of quality should drive product design and manufacturing system.

4. Manufacturing flexibility is essential to maintain high quality and low cost with an increasingly differentiated product line.

5. Mutual respect and support should exist among an organization, its employees, its suppliers, and its customers.

6. A team effort is required to achieve world class manufacturing capability.

7. The employee who performs a task is the best source of suggested

improvements.

JIT as an Environment

In addition to philosophical concepts, JIT also provides an environment in which products are manufactured in a simpler way.

1.Repetitive Manufacturing
2.Total Quality Management (TQM)
3.Total Productive Maintenance (TPM)
4.Total Employee Involvement (TEI)
5.Supplier Partnership

1.Repetitive Manufacturing

Repetitive manufacturing is the production of discrete items in a production line with fixed routings. The items can be a product or a family of products. The product is standard or made from standard modules. The manufacturing environment is make-to-order (MTO) or assemble-to-order (ATO). The production line consists of workstations located close together and in sequence. Materials flow from a workstation to the next at a relatively constant rate. Material handling systems are normally used to move the materials from process to process in the production line. Normally, the capacity of the production line is kept sufficient. The repetitive manufacturing is based on an uninterrupted flow of materials.

2.Total Quality Management (TQM)

Total quality management is a management approach used to achieve improvement and long-term success through customer satisfaction. TQM involves all members of the organization, and is meant to improve the quality of all processes, products, services, operations, and corporate culture.

3.Total Productive Maintenance (TPM)

"Preventive maintenance" is a restrictive term which mentally prohibits us from thinking more broadly. TPM means preventive maintenance and continuing efforts to adapt, modify, and refine equipment in order to increase flexibility, reduce material handling, and promote continuous flows. It is operator-oriented maintenance involving all qualified employees in all maintenance activities.

4.Total Employee Involvement (TEI)

Elimination of waste and continuous improvement are the central ideas of the JIT philosophy. They can be accomplished only when employees are cooperative. A successful JIT environment should have the cooperation and involvement of everyone in the organization. Traditionally, operators take orders from management and do what they are asked to do, while management is in charge of planning, supervising, inspecting, etc. In a JIT environment, operators take responsibility for controlling the equipment, inspecting for quality, correcting the deviations, maintaining the machines, and improving the processes.

5.Supplier Partnership

In order to establish a smooth flow of materials into the factory, a close and reliable relationship with the suppliers is very important. Supplier partnership is the establishment of a working relationship with a supplier whereby the two organizations act as one. Relationships with the suppliers should be based on mutual trust, cooperation, and long-term commitment.

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3.Sixth Sense Device

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'SixthSense' is a wearable gestural interface that augments the physical world around us with digital information and lets us use natural hand gestures to interact with that information.We've evolved over millions of years to sense the world around us. When we encounter something, someone or some place, we use our five natural senses to perceive information about it; that information helps us make decisions and chose the right actions to take. But arguably the most useful information that can help us make the right decision is not naturally perceivable with our five senses, namely the data, information and knowledge that mankind has accumulated about everything and which is increasingly all available online. Although the miniaturization of computing devices allows us to carry computers in our pockets, keeping us continually connected to the digital world, there is no link between our digital devices and our interactions with the physical world.

- ***Keywords:****Microphone, Camera, Hand Gestures, Multi-Touch based systems, Augmented*

History of Sixth Sense

Idea behind this marvelous technology was started late in 1990's by Steve Mann at MIT who actually proposed first wearable computer. First proposed head worn projector and camera in 1994, then he developed it and proposed neck worn projector and camera during 1998 and further in the future developed by Pranav Mistry who is a PhD student in the Fluid Interfaces Group at MIT Media Lab. We can consider Steve Mann as the

"father of emergence Sixth Sense" technology. The first archetype of the sixth sense was very much bigger and was not working properly to use daily so they came out with a modified neck worn type which was like a pendant. In the first article by Arjun KR says that they started working with a big projector mounted on a helmet but that proved cumbersome if someone was projecting data onto a wall and then turned to speak with a friend then data will project on friend's face thus mistry switched up with a smaller projector and created the pendant prototype to be worn around the neck. The archetype was built from an ordinary webcam and a battery-powered 3M projector, with an attached mirror and all connected to an internet-enabled mobile phone here.

Why Sixth Sense?

Human makes decision after sensing everything but information which is collected by human are insufficient to take right decision. But information which could help making a good decision is largely available on net. Information can be collected by mobile, computer etc. but it is restricted to interface or screen and no direct relation between tangible physical world and intangible digital world. Give freedom to interact with physical world by mere hand gesture. Most used in artificial intelligence this methodology can aid in synthesis of bots that will be able to interact with humans.

Introduction

The Sixth sense technology bridges the breach between real world and digital world physical object became part of this technology. Sixth sense work is a adornment like mobile wearable gestures. Camera, mirror, projector connected wirelessly to a Bluetooth smart phone that can slip comfortably in your pocket. Camera recognizes individual images, pictures and gestures one make with their hand. The Information sent to smart phone for processing. The projector faces downward and project the output image on the mirror so that we can adjust the

focus and project on the desired surface. Thus freed from its confines and placed in physical world.

Information is confined traditionally on paper or digitally on a screen. Sixth Sense bridges this gap, bringing intangible, digital information out into the tangible world, and allowing us to interact with this information via natural hand gestures. 'Sixth Sense' frees information from its confines by seamlessly integrating it with reality, and thus making the entire world your computer. The Sixth Sense prototype is comprised of a pocket projector, a mirror and a camera. The hardware components are coupled in a pendant like mobile wearable device. Both the projector and the camera are connected to the mobile computing device in the user's pocket. The projector projects visual information enabling surfaces, walls and physical objects around us to be used as interfaces; while the camera recognizes and tracks user's hand gestures and physical objects using computer-vision based techniques. The software program processes the video stream data captured by the camera and tracks the locations of the colored markers (visual tracking fiducially) at the tip of the user's fingers using simple computer-vision techniques. The movements and arrangements of these fiducially are interpreted into gestures that act as interaction instructions for the projected application interfaces. The maximum number of tracked fingers is only constrained by the number of unique fiducially, thus Sixth Sense also supports multi-touch and multi-user interaction. The Sixth Sense prototype implements several applications that demonstrate the usefulness, viability and flexibility of the system. The map application lets the user navigate a map displayed on a nearby surface using hand gestures, similar to gestures supported by Multi-Touch based systems, letting the user zoom in, zoom out or pan using intuitive hand movements. The drawing application lets the user draw on any surface by tracking the fingertip movements of the user's index finger. SixthSense also recognizes user's freehand gestures (postures). For example, the SixthSense system implements a gestural camera that takes photos of the scene the user is looking at by detecting the

'framing' gesture. The user can stop by any surface or wall and flick through the photos he/she has taken. Sixth Sense also lets the user draw icons or symbols in the air using the movement of the index finger and recognizes those symbols as interaction instructions. For example, drawing a magnifying glass symbol takes the user to the map application or drawing an '@' symbol lets the user check his mail. The Sixth Sense system also augments physical objects the user is interacting with by projecting more information about these objects projected on them. For example, a newspaper can show live video news or dynamic information can be provided on a regular piece of paper. The gesture of drawing a circle on the user's wrist projects an analog watch.




Create your own Sixth Sense Device

Components

1.Camera

The camera is the key input device of the Sixth Sense system. The camera acts as a digital eye of the system. It basically captures the scene the user is looking at. The video stream captured by the camera is passed to mobile computing device which does the appropriate computer vision computation. The major functions of the camera can be listed as:

- *Captures user's hand movements and gestures (used in reorganization of user gestures)*
- *Captures the scene in front and objects the user is interacting with (used in object reorganization and tracking)*
- *Takes a photo of the scene in front when the user performs a 'framing' gesture*
- *Captures the scene of projected interface (used to correct the alignment, placement and look and feel of the projected interface components)*

2.Projector

The projector is the key output device of the SixthSense system. The projector visually augments surfaces, walls and physical objects the user is interacting with by projecting digital information and graphical user interfaces. The mobile computing device provides the projector with the content to be projected. The projector unit used in prototype runs on a rechargeable battery. The major functions of the projector can be listed as:

- *Projects graphical user interface of the selected application onto surfaces*

or walls in front

- *Augments the physical objects the user interacting with by projecting just-in-time and related information from the Internet*

3.Mirror

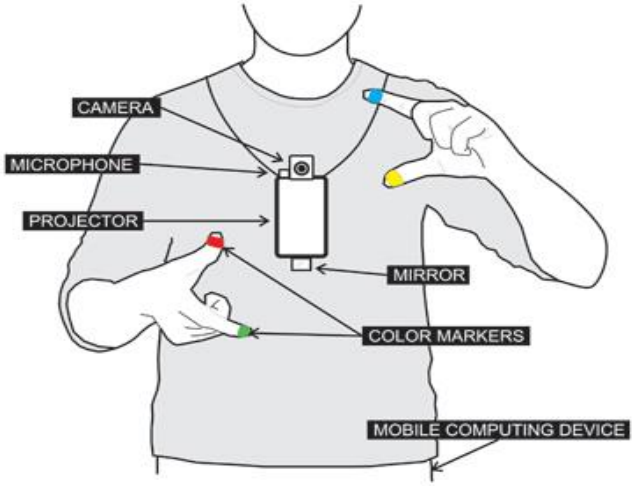
The mirror reflects the projection coming out from the projector and thus helps in projecting onto the desired locations on walls or surfaces. The user manually can change the tilt of the mirror to change the location of the projection. For example in application where the user wants the projection to go on the ground instead of the surface in front, he can change the tilt of the mirror to change the projection. Thus, the mirror in the SixthSense helps in overcoming the limitation of the limited projection space of the projector.

4.Microphone

The microphone is an optional component of the SixthSense. It is required when using a paper as a computing interface. When the user wants to use a sheet of paper as an interactive surface, he or she clips the microphone to the paper. The microphone attached this way captures the sound signals of user's touching the paper. This data is passed to computing device for processing. Later, combined with the tracking information about user's finger, the system is able to identify precise touch events on the paper. Here, the sound signal captured by the microphone provides time information whereas the camera performs tracking. The applications enabled by this technique are explained earlier.

Mobile Computing Device

The SixthSense system uses a mobile computing device in user's pocket as the processing device. The software program enabling all the features of the system runs on this computing device. This device can be a mobile phone or a small laptop computer. The camera, the projector and the microphone are connected to this device using wired or wireless connection. The detail of the software program that runs on this device is provided in next section. The mobile computing device is also connected to the Internet via 3G network or wireless connection.



Now that you have all these pieces, you need a way to combine them. We recommend using Lego strips to form the base. The projector, camera, and mirror assembly can be directly put onto this base. You can also use Velcro to combine the products.

How to run the Software Component of SixthSense

The prototype system runs on windows platform and majority of the code is written in C++ and C#. We will be uploading newer versions as it is being

developed; this will also include a mobile version.

Instructions for running WUW_v0.1

WUW_v0.1 is the beta version of SixthSense code (WUW stands for Wear Ur World, a former name of the project). This version runs on Windows. Make sure you have Visual Studio and Direct X installed. Extract and copy the files from wuw_v0.1.zip to any location on your computer. Open WUW01.sln (which is present in the folder "CODE") then click on F5 to debug it. If you debug it successfully, a black screen appears with a little square box on the right just hover your mouse around it and you will find Option tabs such as Camera, Tokens and Apps.

***Camera**: you can choose which camera to use and configure the camera settings here. You may need to mirror the camera here using the camera settings. It is also recommended to use fixed/manual white balance and exposure such that the camera image is stable and light independent.*

***Tokens**: This version of code uses colored fingertips as markers. One need 4 different colors in order to run most of the Apps. We recommend to use Red, Yellow, Blue and Green (or colors that are different enough). We have also noticed that the matt colored tape/objects works better as they have less reflective changes. When you click on 'Add Markers', the screen starts blinking and after 4-5 sec's it stops with a still picture so that you can add those markers on your hand as new markers. You can simply drag-select the colored marker on the screen by mouse cursor. Once you have all four markers (O, P, M, and N) added the software will start tracking the four markers. You can set the thresholds to better the tracking. You can save those markers and can reuse in subsequent executions, or can add new markers every time.*

***Apps**: there are three ways to launch any application. Apps tab can let you choose the apps you want to load and run. One can also load apps from 'Menu'. 'Menu' is triggered using Namaste gesture. Once on Menu screen you can choose the App by hand-click (Hand Click gesture works by moving the O marker and hiding P marker.)*

Conclusion

Relate with the information via natural hand gestures and enables you the whole world at your fingertips-literally. Transparency between user boundary for accessing information about everything around us and this is classified under wearable computing. Recognize the object and give information about it and give freedom to access.

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"Start where You Are;

Use what you have;

Do what You can."

- Arthur Ashe

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