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Highlights

- Wireless Body Area Network
- Whiteness Index and Bursting
- Wheel Self-Balancing Robot
- Scouring and Bleaching Agents

Discovering Thoughts, Inventing Future

VOLUME 19 ISSUE 1 VERSION 1.0

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Remote Health Monitoring System using Wireless Body Area Network

By MD. Zahidul Islam, Sazzad Hossain Rafi & MD. Murad Miah
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Abstract- The rapid increase of wireless technologies and body area networks has enabled the continuous healthcare monitoring of patients from a remote location using various sensors. This paper describes a remote health monitoring system using WBAN where different sensors are used to collect a patient's vital signs. Once the data is received, the captured data are evaluated by the Arduino and sent to the patient's Android Smartphone using a Bluetooth module and a newly developed android application named Health Monitoring App. Data can be accessed by the patient himself, by doctor or patient's family members. In critical conditions such as when body temperature and pulse rate goes beyond a predefined value or patient fall down, then application from patient's smart phone triggers a message to deliver to the doctor or relatives with the location of the patient using built-in GPS in patient's phone. This remote health monitoring system is very feasible and cost-effective for a developing country like Bangladesh.

Keywords: body movement monitoring, health monitoring, wireless body area networks (WBAN), body condition analysis.

GJRE-J Classification: FOR Code:100510

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Remote Health Monitoring System using Wireless Body Area Network

Md. Zahidul Islam [α], Sazzad Hossain Rafi [σ] & Md. Murad Miah [ρ]

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Keywords: body movement monitoring, health monitoring, wireless body area networks (WBAN), body condition analysis.

I. Introduction

Body area networks (BANs), also referred to as body sensor networks (BSNs), can be used for patient health monitoring. Wireless body area networks sense physiological activities of a human using a collection of sensor nodes which are smaller in size and have less power consumption. Then the data have to send to a microcontroller for further processing [1]. Body area networks benefit from the advancement of smart and inexpensive health monitoring systems [2]. They can also use as diagnostics, maintenance for specific health conditions and remote health observation. Body area networks employ features which are better suited for patient health monitoring compare with traditional wireless sensor networks (WSNs) [3]. Wireless body area networks are two types: in-body and on body. Both are frequently used for constant monitoring of the vital signs of a patient with proper diagnosis [4, 5].

II. Remote Health Monitoring System

In our developed system, a patient is monitor by the doctor or his family members from a remote place. The device will able to take data or vital signs such as body temperature, pulse rate, sense patient falling condition then send it to a microcontroller. Microcontroller further process the data, send to the patient's smart phone through a Bluetooth device. Where an android application used to check the data and this application will send a message to doctor or relative's phone after predefined time interval including information about body temperature, heart rate, body movement condition and patients location from Google map automatically. If heartbeat rate, body temperature goes higher than a predefined value or patient fall down then an automatic emergency message will go to doctor's or relative's phone from patient's mobile application using mobile networks.

There will be a couple of sensors like temperature sensor, pulse sensor, accelerometer and gyroscope sensor to detect the patient's temperature, heart rate and body movement information. For this system, sensors, Arduino Nano and a power source have used. An Arduino is use to evalute captured data and send to the patient's smartphone. The patient can move from one place to another with the device. Developed health monitoring system contains both a hardware part and a software part. The operation of our health monitoring system is shown below with a flow chart.

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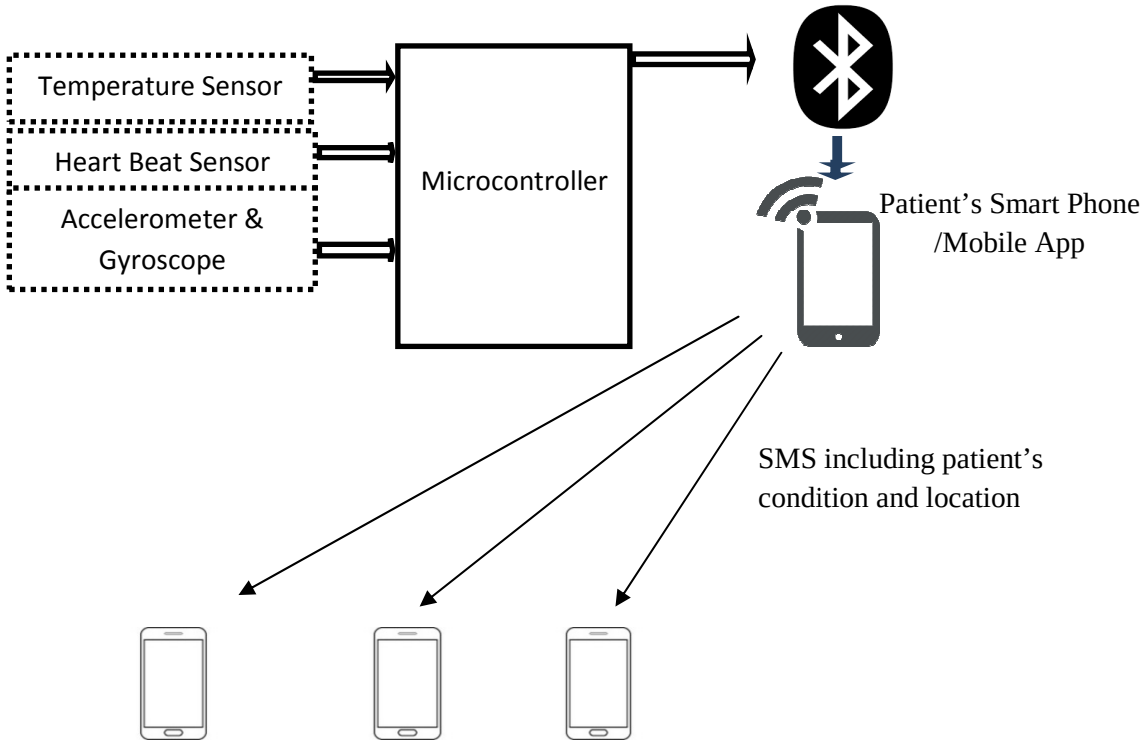

Figure 1: Block diagram of health monitoring and Alerting System.

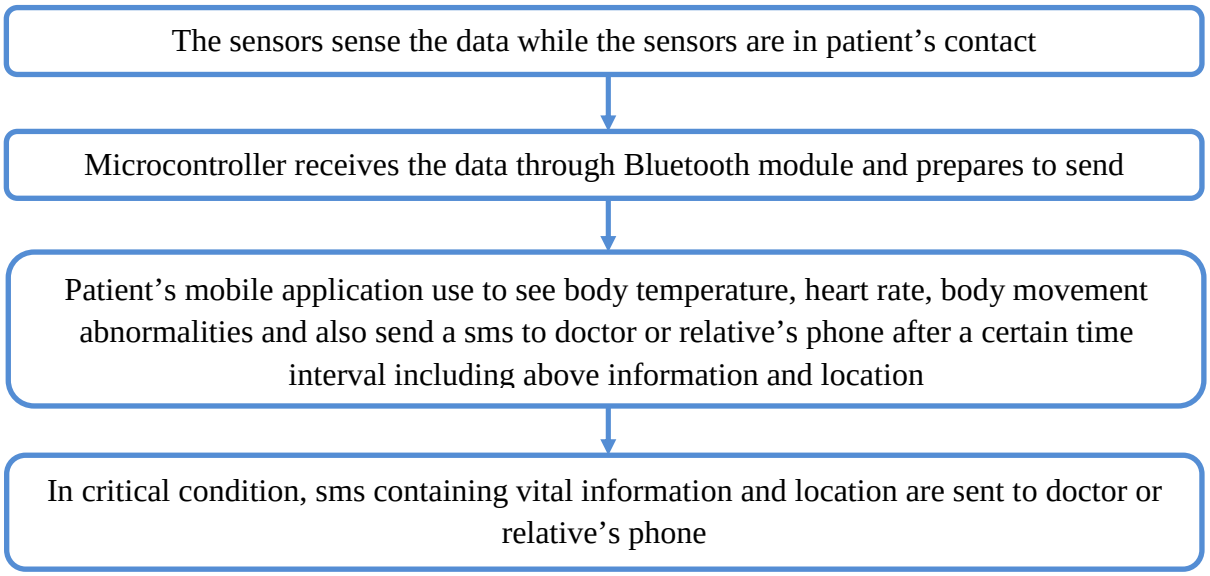

Figure 2: Flow chart showing the operation of the remote health monitoring system.

III. Parameters Estimation and Calculation

a) Body Temperature

LM35 temperature sensor is use to measure the temperature. LM35 is a precision IC temperature sensor with its output proportional to the temperature. Let p is the value collected from Arduino analog pin and q is a variable.

$$q = \frac{p*5000}{1024} \quad (1)$$

$$\text{Celsius value} = \frac{q}{10} \quad (2)$$

We can convert this Celsius value to Kelvin & Fahrenheit value.

$$\frac{C}{5} = \frac{F-32}{9} = \frac{K+273}{5} \quad (3)$$

Where, C = Celsius value, F = Fahrenheit value, K = Kelvin value

As we get Celsius value, we can convert this to Fahrenheit value. As normally we use Fahrenheit to measure our body temperature. So it is necessary to convert from Celsius to Fahrenheit.

$$F = \frac{9*C}{5} + 32 \quad (4)$$

$$K = C + 273 \quad (5)$$

By using those data, we can easily convert from one unit to another.

b) Heart Beat Per Minute (BPM)

The heartbeat sensor is based on the principle of photoplethysmography. It measures the change in volume of blood through any organ of the body which causes a change in the light intensity through that organ. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by blood, the signal pulses are equivalent to the heartbeat pulses. Pulse sensor SEN11574 is a very common sensor for measuring pulse rate. By just clipping the sensor to fingertip we can collect heart rate data.

c) Body Movement

If someone's body movement is abnomal then this device can detect the movement condition or fall. To detect normal or abnormal movement, MPU-6050 Accelerometer and Gyroscope has used in this system. The MPU6050 has an embedded 3-axis MEMS gyroscope, a 3-axis MEMS accelerometer. It is useful for some motion detection. For detecting how fast the acceleration is changing, we have used the concept of Standard deviation. Standard Deviation of the X-axis acceleration, Y-axis acceleration, Z-axis acceleration was measured by the function of a second. There arrive almost ten values in per second.

The formula for Standard deviation:

$$\text{Standard deviation} = \sqrt{\Sigma(x - \bar{x})^2 * \frac{1}{n}} \quad (6)$$

Where, x = acceleration of a certain moment, $\bar{x}$ = average acceleration for a single second, n = number of acceleration data in a single second.

By using standard deviation, we can take some decision about the pattern of body movement. If the person is walking than the x, y, z-axis acceleration is different from standing. By taking data in different condition and analyzing them, we can decide normal, abnormal body movement or falling situation.

IV. System Implementation

a) Hardware Implementation

Wireless Body Area Network (WBAN) has been implemented here using Fritzing [6]. Various mathematical equations have been used to determine some parameters which are needed to analyze. Temperature sensor, Pulse sensor, Accelerometer and gyroscope sensor is connected the microcontroller. The microcontroller then sends the data to the patient's Smartphone. By using GPS, we can also detect the patient's location.

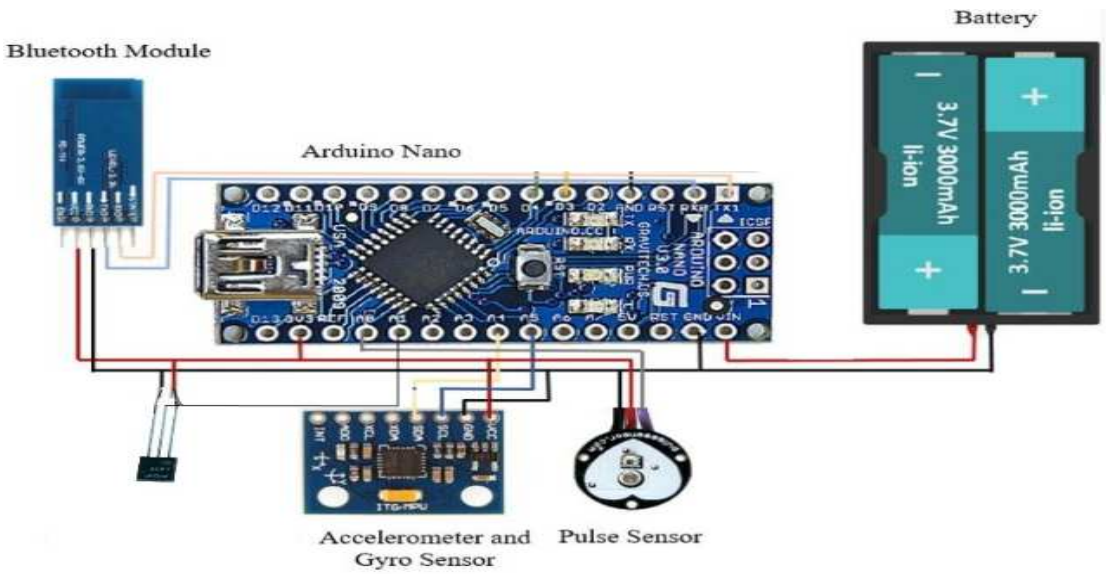

Figure 3: Implementation of hardware for remote patient monitoring system.

b) Development of Mobile Application

The primary task of our project was to take data from the sensors. The captured data are evaluated by the Arduino and sent to the patient's phone. A mobile application is needed to receive the data from a microcontroller and to send SMS to a doctor or relative's phone. Our fundamental objective was to give a stage to the patient, doctor, and family members to

communicate simply without being available by physical. We have mainly focused on developing countries people where majority use Android device. Therefore it was another reason to choose Android mobile application. We have selected the name, 'Health Monitoring' for android the app. One app will belong to the patient only which will display his health parameters in real time as well as send vital information including patient's location via SMS service. Android Studio is used here to create an android application that will receive data from Arduino through Bluetooth device. Android Studio is the official Integrated Development Environment (IDE) for Android app development, based on IntelliJ IDEA. On top of IntelliJ's powerful code editor and developer tools, Android Studio offers even more features that enhance the productivity of the Android apps.

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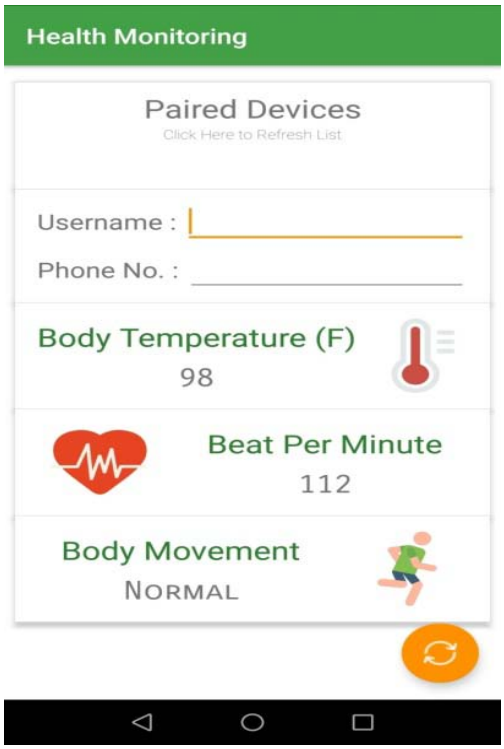

Figure 4: 'Health Monitoring' app to receive data from a microcontroller via Bluetooth module.

V. Results and Analysis

To verify whether our device is giving a better output or not we compared the outcome with the result that we get from a thermometer. As we are taking temperature and pulse rate, we need to make sure that our device produces an almost accurate output. We do the same process for falling condition analysis.

Table 1: Comparing the output with expected output (Body Temperature).

Temperature using Thermometer	Temperature using Device	Percentage of Error
98F	99F	1.02%
100F	101F	1.00%
97F	98F	1.03%
98F	99F	1.02%

Table 2: Comparing the output with expected output (Pulse Rate).

Pulse Rate (Manually)	Pulse Rate Using Device	Percentage of Error
60 bpm	65 bpm	8.33%
70 bpm	75 bpm	7.14%
75 bpm	78 bpm	4.00%
76 bpm	80 bpm	5.26%
110 bpm	112 bpm	1.82%

Table 3: Comparing the output with expected output (Fall Detection).

Number of trial for fall detection	Number of Success	Number of Failure	Percent of Success
50	41	09	82%

In this developed system, there is an option of SMS that is send to the doctor's or family member's emergency phone number. It is an auto-generated message. An automatic message will send if the sensor value exceeds a value. The conditions for triggering an SMS: (i) If Body Temperature is greater than 101 Degree Fahrenheit (ii) If Pulse Sensor Value is more than 120 or less than 60 and (iii) If Body Movement is abnormal.

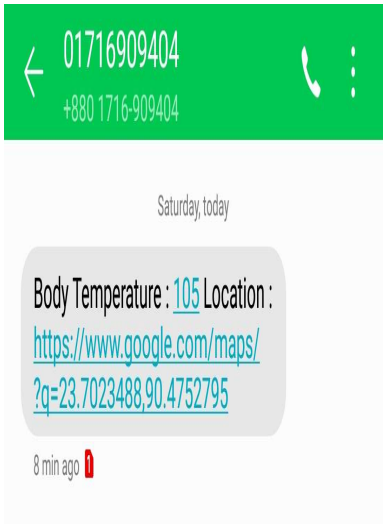

Figure: SMS for body temperature.

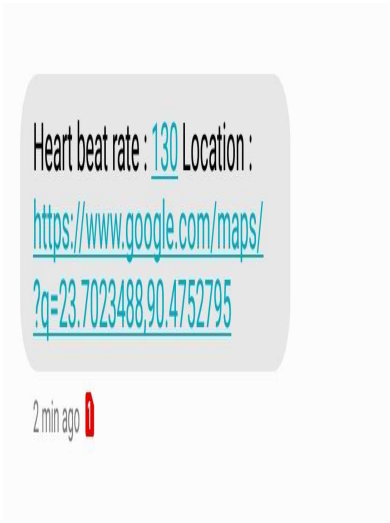

Figure: SMS for heart beat rate.

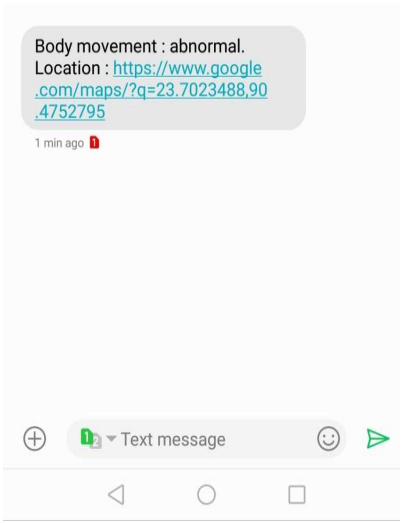

Figure: SMS for body movement/Falling condition.

VI. Feasibility Analysis

Feasibility analysis is used to aid the decision of whether or not to proceed with the proposed system. This system is independent and easy to use. Therefore it can be used at home or any remote location. In our country, the government and NGO's give a specific amount of money for healthcare development purpose. If patients use this device, that will be very cost effective and efficient for a developing country like ours.

VII. Cost Analysis

In developed countries like ours, there is few health monitoring devices which are very expensive. Our purpose is to make a device which is suitable for developing countries. See below for the total cost of this remote health monitoring system.

Components	Price (BDT)	Price (USD)
Arduino Nano	600.00	7.10
LM-35 temperature sensor	60.00	0.72
SEN-00162pulse sensor	1550.00	13.70
MPU-6050(3-Axis Accelerometer & Gyroscope Sensor)	180.00	2.15
HC-05 Bluetooth module	280.00	3.34
Total Price	2670.00	28.00

VIII. Conclusion

Human body temperature, heart rate, body movement are the most important thing to analyze one's body condition. This paper illustrates and focuses on the sensors and their output result and remote patient monitoring. By this way, it is possible to know patient's body condition within a moment with exact location tracking system. People from anywhere and anytime can monitor patient especially elderly aged people. As there is not much complexity, it is easy to use. Because of being software-based, it has become very feasible.

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Control Unit for a Two-Wheel Self-Balancing Robot

By D.P.V.J. Jayakody & K.P.G.C. Sucharitharathna

Abstract- A self-balancing personal transporter which is based on the inverted pendulum concept has sufficient potential to provide solutions for the upcoming global issues in the transportation industry. However due to the expensive price range which the self-balancing scooters are introduced at and few safety issues, this concept has failed in reaching the hands and becoming popular among the majority of the society. Therefore this research paper consists of a comprehensive literature review on the existing models of the self-balancing transporter scooters, possible ways to reduce the initial cost of implementing a control unit for self-balancing transporter vehicles and methods to address the issues which generate along with the proposed cost-reduction methods. Real-time comparison of Kalman and Complementary filtering processes are performed to sort out the optimum algorithm to estimate the true angle of the inclination of the self-balancing prototype. Similarly several forms of control system implementation are compared through simulations and real-time experiments to obtain the ideal motor response for variations in the position of the prototype.

Keywords: inverted-pendulum, PID control, self-balancing robot, complementary filter, kalman filter, MPU6050.

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I. Introduction

In today's society transportation is undoubtedly a fast-growing industry. Due to the rapid growth in the demand for personal transporter vehicles, self-balancing personal transporter scooters were introduced by the Segway Company. For the intention of increasing the efficiency of humans and to reduce the cost, the self-balancing personal transporter which is also a great representation of the personal mobility device concept is now widely used in many industries and institutions such as police departments, tourism industry, factories, and airports. The benefits which are offered by this personal transporter vehicle such as higher accessibility and zero fuel consumption can be considered as the ultimate solutions for the upcoming global issues caused by the growth of traffic and the environmental pollution happening all around the world. Even though the self-balancing transporter represents a better version of the personal transporter type vehicles that are being used nowadays, it simply failed in reaching the hands of the majority of society due to the expensive price range and the safety issues pointed out by the existing users of these self-balancing transporter models. The self-balancing personal transporter models (mainly Segway models) are comprised of multiple gyroscope and accelerometer sensors (few as additional) to obtain the angular rate and acceleration readings along different axes.[1] The drawback which comes along using multiple sensors is the additional cost and the extra computational power required by the control unit. In addition to being expensive, the fact of having none of the common safety system features available in the modern vehicles to increase the passenger's safety can also be considered as a cause of the failure of self-balancing personal transporter concept.

The working principle of a self-balancing personal transporter is involved in continuously obtaining the feedback of the tilt (angle of inclination) of the platform, compensating the error with respect to the reference angle and maintaining the entire platform in an upright position. Further the ability of responding to any unexpected external force being applied in order to recover back to the stable position has been included in the control unit of the self-balancing transporter platform as it improves the overall safety assurance of the passenger

For the self-balancing transporter prototype presented by this research paper, an IMU unit (MPU6050) which is comprised of built-in accelerometer and a gyroscope is used to measure the acceleration and angular velocity readings along multiple axes and the angle of inclination of the platform can be simply estimated from both of these measurements separately.[7] However a single IMU unit which performs the task of multiple gyroscope and accelerometer sensors typically offer output signals combined with serious noise and therefore these signals are required to pass through a noise filtering process to achieve true angle of inclination estimation values. The main considerable noise components generated by the IMU unit can be listed as the gyroscopic drift and the horizontal acceleration dependency. Therefore a nose filtering process such as Complementary filtering or Kalman filtering can be applied to the IMU unit's output to obtain a better estimation of the angle of inclination of the self-balancing platform. The filtering process to be implemented highly depends on the performance of the microcontroller unit of the self-balancing transporter and it could also end up in indirectly affecting to the total

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implementation cost. Finally a control system is required to control the motors of the self-balancing transporter with respect to the estimated angle of inclination and therefore the speed of the motors has to vary in order to maintain the platform in the upright position. A PID system is implemented as the control system of the self-balancing prototype and further designing phases with circuitry work are carried out to add a more professional touch to the implementation of the control unit of the self-balancing platform.

II. Literature Review

Comprehensive research was carried out to find out the information about the existing self-balancing transporter products and to reveal out design architectural information in order to implement a low-cost control unit for a self-balancing transporter vehicle.

a) *Segway Self-Balancing Scooter Models*

'Segway' company led by the inventor Dean Kamen was the very first to introduce a two wheeled self-balancing personal transporter type scooter in 2001. Even though the Segway was appeared to be a completely new form of transportation in the early stages, the concept completely failed in building a considerable customer base due to its' extremely high introductory price. Therefore in 2006, the company came up with a couple of new designed two-wheeled self-balancing personal transporters to suit different types of terrains. Segway I2 was introduced as the on-road general purpose personal transporter model while the Segway X2 model was designed with more advanced features for rough terrains and introduced as the off-road model. [2]

Figure 1: Segway I2 Model [2]

Figure 2: Segway X2 Model [2]

Both of these models consist of the working principle which requires the rider to lean forward to travel forward and do the opposite to move backward. Once the rider leans to the forward or reverse directions; the self-balancing scooter will start to move in the desired direction by maintaining the tile angle of the entire platform. The rider on the self-balancing scooter gets the opportunity to tilt the handlebar to drive the scooter in different directions. The tilt of the scooter platform is measured by a sensor unit consists of five gyroscope sensors and two accelerometer sensors.[2] Accelerometers and gyroscope sensors work separately to process the multiple accelerations and angular rate readings along multiple axes precisely in an extremely fast rate, the controller units of these personal transporter models are equipped with a highly powerful, expensive unit comprising of ten on-board microprocessors.[2] These facts can be considered as the major reasons for the Segway products to be tagged at an expensive price range. (Above $5000) However, these Segway models do not consist of any passenger safety features such as obstacle detection and braking system methods and as a result in most countries these models are banned from using in the public roads.[3]

b) *Hover Boards*

Hover boards can also be introduced as a representation of the self-balancing transporter concept. The steering operation is entirely different compared to self-balancing scooter models as the pressure sensor plates are placed on the pedal surface of hover boards to calculate the pressure difference and determine the turning direction. However the similar feature of both of the products can be highlighted as the self-balancing driving method which requires the rider to lean forward or reverse in order to move in the desired direction. The speed control unit of the hover board consists of two separate gyroscope sensors and two tilt sensors to obtain the angular rate and the accelerations along different axes to determine the tilt angle of the platform. (Figure 3) Even though there is a noticeable reduction in the number of accelerometer and gyroscope sensors compared to the control unit of the Segway models, the multiple gyroscope and accelerometer units in a hover board would still demand higher processing power.

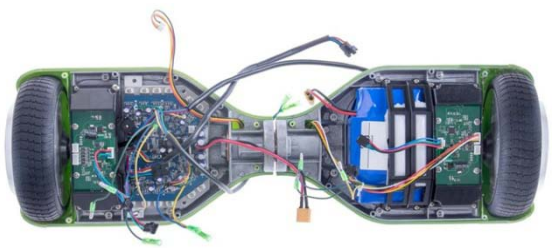


Figure 3: Inside of a hover board (Showing two separate speed control units)

III. Process of Obtaining the Angle of Inclination

The angle of inclination of the self-balancing prototype platform was obtained through the accelerometer readings of the IMU unit. Acceleration readings had to be converted into the degrees by considering the inverse tangent angle calculated from the acceleration readings alone y and z-axes. Changes in the angle of inclination concerning time had to be calculated by multiplying the angular velocity reading of the gyroscope of IMU with the time difference.

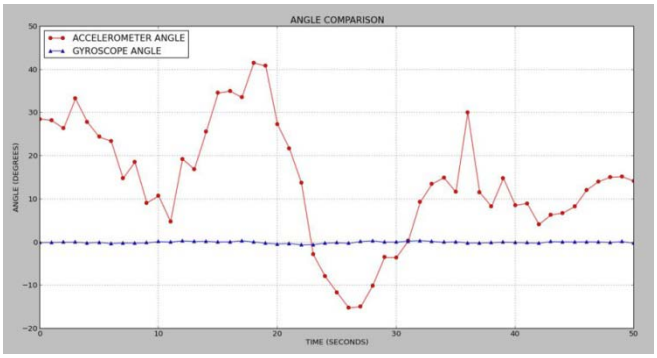


Figure 4: Real Time Python plot displaying the angle readings

IV. Implementation of the Noise Filtering Algorithms

a) Estimation of the true angle of inclination

The position and the stability of a self-balancing robot are simply affected by accelerations acting on it and the changing angular velocity of the robot platform. Therefore it was clear that both angle of inclination values and the angular change derived from accelerometer and gyroscope readings are required for a better estimation of the true angle of inclination of the self-balancing platform. Therefore the 'Sensor fusion' technique which is an input combination of multiple sensor readings to derive a single output was applied for the estimation process.

b) Noise observations

To obtain the true angle of inclination, it is obvious that the noises generated by the IMU unit must be cancelled out from a noise filtering process. Generally, the accelerometer is sensitive to the horizontal (x-axis) accelerations, and therefore it considers a horizontal acceleration as a change in the derived angle which causes huge noise in the derived angle output. On the other hand, the gyroscopic angle is sensitive to gyroscopic drift. Gyroscopic drift can be mainly introduced as the non-zero value that the gyroscope outputs when it is stationary even though it is supposed to output zero.

c) Complementary Filter Algorithm Implementation

Complementary filter algorithm which is a combination of high pass, low pass filtering stages and mathematical processes such as integration was selected as the first method to obtain true angle estimation of the platform. The true estimation of a sensor reading using the current and previously obtained sensor measurements can be considered as an intuitive approach for a sensor fusion application. The complementary filtering process inside the self-balancing platform can be represented as,

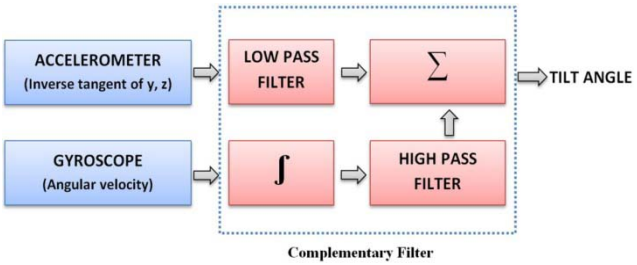


Figure 5: Complementary Filter Structure

Key things that affect the performance of the filtering process can be identified as the time constant and the filtering coefficient of the complementary filtering algorithm which are correlated with each other. Generally the time constant of the low and high pass filters are used to tweak the entire performance as it determines the filter coefficient of the filtering process.

- Complementary filter algorithm theory,
  Filtered angle = a * (current angle + gyro angle) + (1-a) * accelerometer angle [a = Filter coefficient]
- Complementary filter algorithm used for the self-balancing prototype,
  Filtered angle= 0.9934*(previous Angle + gyro_angle) + 0.0066*(accelerometer angle) [0.9934= Filter coefficient]

The value for the filter coefficient was selected as 0.0066 to obtain the most suitable filtered angle output from the complementary filtering process from a range of test data values for the specific prototype dimensions. Complementary filtered angle output was compared with the unfiltered angle values derived from IMU readings to ensure the elimination of horizontal acceleration noise and the gyroscope drift noise components respectively in accelerometer angle and gyroscopic angle.

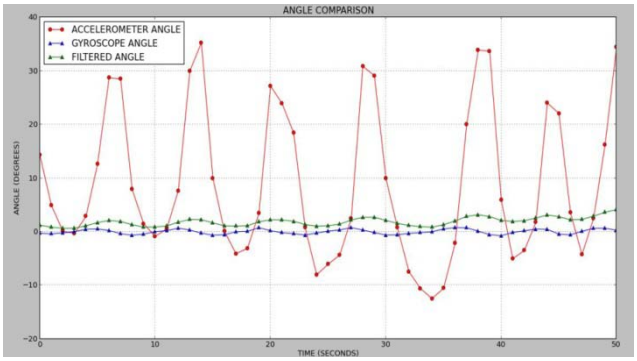


Figure 6: Comparing Complementary filtered angle (Green) with gyroscopic angle (Blue) and accelerometer angle (Red)

As the estimation provided by the complementary filtering process consisted of both the effects of accelerations acting on the prototype's frame and the changes in the angle of inclination (position), it was quite accurately providing the true angle of estimation of the prototype which depends on the entire stability maintaining.

d) Kalman Filter Algorithm Implementation

For a self-balancing platform application, Kalman filtering process can be defined as an iterative mathematical process that uses a set of equations made out of multi-dimensional matrices and data inputs to track objects by estimating the true values of velocity and position. Basically, it is focused on minimizing the variation or uncertainty in the continuous estimates with respect to the velocity and position data measurements. A state matrix (multi-dimensional) is formed to store the velocity and position data of the object which is being tracked. Process covariance (error) matrix contains the error in the estimation process.

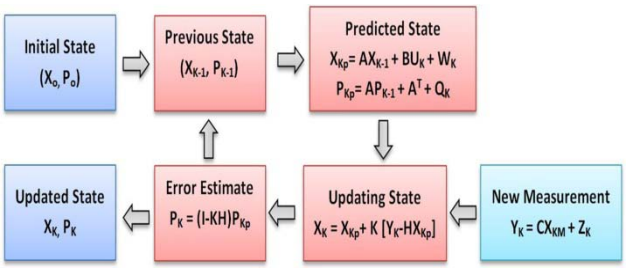


Figure 7: Iterative process for multiple dimensional Kalman filter model

U_k - Control variable matrix.
A, B, C - Adaptation matrices.
W_K - Predicted noise matrix.
X_{KM} - Measurement.
Q_K - Process covariance matrix.
Z_K - Measurement noise.

In the above process, U_K is used to combine a variable (acceleration) that affects both position and velocity to the predicted state. The intention of adaptation matrices is simply to ensure a common format between matrices. New estimate is processed for each data input by modifying the initial predicted state value with a portion multiplied by the Kalman gain (K) which determines the additional weight of sensor measurement and the predicted state value to be added. Kalman gain (K) can be explained with the sensor noise covariance matrix (R) which represents the measurement errors of relevant parameters of the IMU unit as,

$$K = P_{Kp}.H / (H.P_{Kp}.H^T + R)$$

The Kalman filtered angle of inclination was compared with the complementary filtered angle to observe the difference of true angle estimation to sort out the optimum filtering method. From the comparison result (Figure 8), it was clear that the predicted angle by the Kalman filter contains less variation from the true angle and more accurate response towards changes in velocity and position than the Complementary filter.

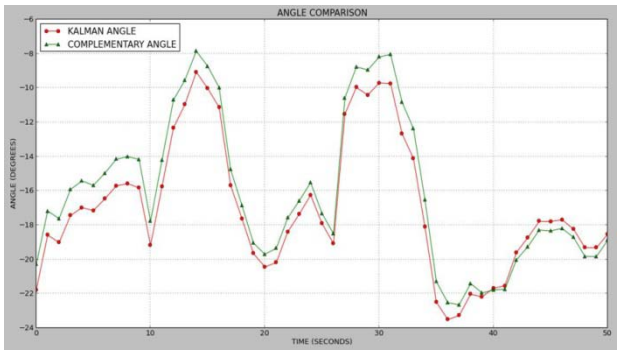


Figure 8: Comparing Kalman filter angle (Red) with Complementary filtered angle (Green)

V. Implementation of the Control System

a) Structure of the PID Control System

The intention of the PID control system is simply to control the motors of the self-balancing prototype according to rapid changes in the position. The basic algorithm to represent a PID control system can be given as [6],

$$u(t) = K_p\, e(t) + K_d \frac{de(t)}{dt} + K_i \int_0^1 e(\tau)d\tau$$

The most important component of a PID control system can be considered as the feedback error value as it's combined with all of the constant values and used to generate the control signal output of the system. In the self-balancing platform, target or the reference angle can be calculated by positioning the robot in the upright position and therefore the feedback error value can be calculated as

e(t) = Current (Filtered) Angle–Target (Reference) Angle

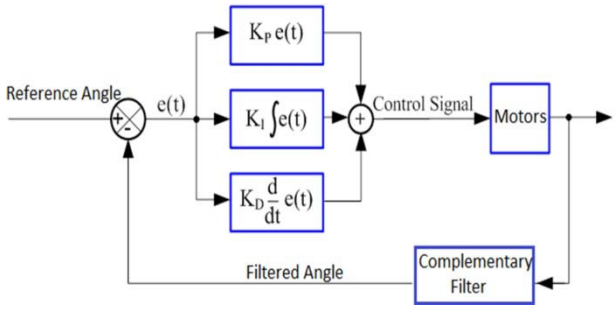
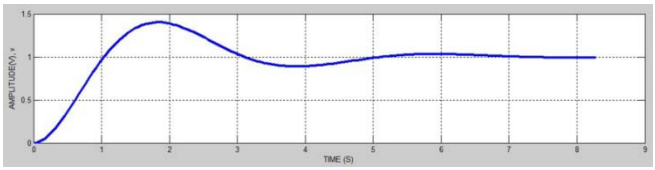


Figure 9: PID Control System Structure

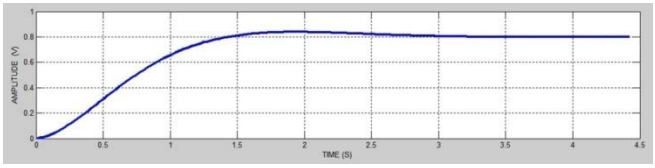
As shown in Figure 8, the output signal of the PID control system is simply fed as the motor power to control the motors of the prototype according to the calculated error (difference) between the reference and the current (filtered) angle. Reference angle of the PID system is found out by measuring the angle of inclination of the platform when the robot frame is placed in an upright position.

b) PID Simulations

Matlab software-based simulations were carried out to find out the optimal values for the control terms (K_P, K_I and K_D) of a P, PD, and a PID controller. Unit step input (error value) for the simulation was generated by inputting a set of random angle value data. The system performance characteristics such as settling time, overshoot and rising time were observed by plotting the step response of the forms of the PID system with different sets of control term values. Depending on the characteristics of the response curve (Unit step response) of the PID, PD and P control systems, some value sets for the control terms were tested to sort out the best possible value range to shorten the settling time and to reduce oscillations in the control signal.



(a).



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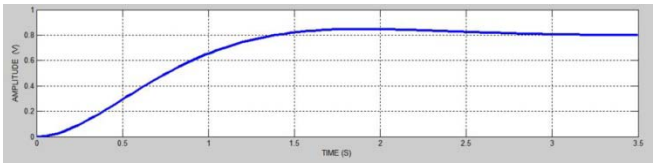

(c).

Figure 10: Step response of the control systems corresponding to optimal constant value sets, a). PID control system (Kp=60, Ki=4, Kd=0.3), b). PD control system (Kp=80, Kd=1.2), c). P control system (Kp=80)

Table 1: Performance Chart of Control System Simulations

Controller Type	Overshoot	Settling Time	Steady state error
PID	High	Very High	Very Low
PD	Low	Low	High
P	Low	Low	High

c) PID Tuning

However throughout practical experiments where manual PID tuning method was used to lock down the optimum control term values, the PID controller's performance with the minimum 'rise time' was not as stable as expected through the above simulation result. On the other hand, the PD controller provided a better stability for the prototype with a minimized steady state error which produced a negligible real-time effect to the overall balancing performance. Even though the performance of both P and PD control systems contain major similarities, the simulation result highlighted the slight increase in the 'rise time' in the P controller compared to the PD controller.

Table 2: Effect of Control Term Values in Tuning Process

Increased Control Variable	Improved Performance
K_P	Stability, Rise time
K_D	Overshoot, Settling time
K_I	Steady state error

As a result, the P controller presented a considerable stable balancing performs with slight oscillations and by assigning a suitable value for the K_D, the controller type was converted into a PD system and the overall performance was improved in to a better standard at the end.

VI. CAD Design and Hardware Implementation

CAD design of the self-balancing prototype was modeled through the 'Sketchup' software to secure the best possible weight distribution of the frame which directly affects to the balancing performance before the hardware implementation of the prototype.

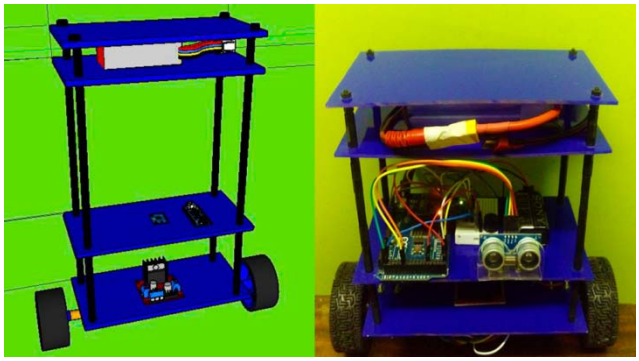

Figure 11: CAD design with the actual hardware implementation

VII. Conclusion and Future Work

The overall performance of the PD controller was ideal for the prototype to reach stability (upright position) with minimized oscillations and the shortest settling period. Further, the prototype was comfortable in responding rapidly to compensate the angle differences (errors) that occurred by various external forces. The control unit built through this research can be reused with relevant PID tuning parameters for differently scaled prototypes or Segway clones.

For similar experiments with self-balancing transporter prototypes, the safety system which was initially implemented through this research can be further improved. The sampling rate used to obtain the IMU readings and for the filtering process was 0.005 milliseconds and it was produced by internal interrupts of the Atmega128 chip. However the requirement of this rapid sampling rate prevented the flexibility of the microcontroller usage to carry out safety system experiments along with the balancing and filtering processes. Therefore as an improvement which is required for further experiments to implement a solid safety system for self-balancing transporter platforms, a separate microprocessor chip can be reserved to avoid conflicts between the priorities of each task. Further to preserve the compatibility of the circuit, both of the chips can be located in the same PCB with proper power distributions.

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Impact of Fabric Density, Color and Composition of Plain Weave Fabric on Ultraviolet Protective Factor

By Marzia Islam, Tarifun Akter, Jannatul Ferdush & Kamrunnahar
Northern University

Abstract- In this study, the effect of fabric density and different colors (black and red) on ultraviolet protection factor of woven fabric investigated. The fabric of different composition (100% cotton, 60/40 CVC), two color (black, red) and various density (Ends per inch, Picks per inch) collected. Then UPF rating was measured by spectrophotometer in vitro method. Experimental result showed that higher the fabric density and weight; higher the protection from ultraviolet rays. Besides, it also revealed that black fabric has more UV protection ability than the red one. Another finding of this study is that polyester content increases the UPF value.

Keywords: fabric density, composition, color, fabric weight, ultraviolet protective factor.

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Marzia Islam [α], Tarifun Akter [σ], Jannatul Ferdush [ρ] & Kamrunnahar [ω]

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I. Introduction

Skin disease including skin cancer has become very common now a days. UV radiation from sun is the primary cause for skin cancer according to many researchers [1, 2]. Sun radiation has a continuous energy spectrum radiates from sun in the wavelength range of about 0.7 nm to 3000 nm. Only 280 nm to 3000 nm solar radiation can reach on the earth surface [3], where the wavelength of the ultraviolet spectrum lies between 290 nm to 400 nm. Overexposure to UVR has the most adverse impact onerythema and skin cancer, which increased the public awareness of adopting personal UV protective schemes such as the use of sunscreen on the exposed parts of body [4]. Besides using sunscreen and shading, people can also cover their body by wearing textile garments to protect from UVR [5, 6, 7]. But before selection of garments the fabric parameters like fabric density, color, weight should be considered to get better UV protection. I. M. Algaba, Achwal, B. R Daset al. showed the effect of thickness and weight on UV protection of cellulosic woven fabric [8, 9, 10]. Moon and Pailthorpe found that stretching elastane-based garments have lower UPF than unstretched garment [11]. To make a comparison of the ultraviolet protection factor of different composition, weight and color plain fabric is the aim of this study.

II. Material and Method

Two color black and red 100% cotton and 60% cotton 40% polyester plain fabric of different ends per inch, picks per inch collected from Evince limited. Then the samples are conditioned at relative humidity 65±2%, Temperature 20±2^{0}C at least 24 hours.

UPF Measurement: In this study, ultraviolet protective factor (UPF) represented the UV protective capabilities of woven fabrics from sunburn as a quantitative indicator. UV protection ability of cotton and blended plain fabrics measured by vitro approach. Ultraviolet protection factor in the vitro measurement conducted with a spectrophotometer in accordance with the AS/NZS 4399 standard.

Following is the equation of calculating UPF:

$$\text{UPF} = \frac{\sum_{290}^{400} E_\lambda S_\lambda \Delta_\lambda}{\sum_{290}^{400} E_\lambda S_\lambda T_\lambda \Delta_\lambda}$$

Where,
E_λ is the erythemal spectral effectiveness.
S_λ is the solar spectral irradiance (in W·m−2·Nm−1).
T_λ is the spectral transmission through the textile.
Δ_λ is the bandwidth (in nm).
And λ is the wavelength (in nm) [12].

The current Australian/New Zealand Standard has three major categories According to Australian Radiation Protection and Nuclear Safety Agency (ARPANSA),

Table 1: UPF rating and protection category [13]

UPF Rating Protection	Category	% UV Radiation Blocked
15 - 24	Good	93.3 – 95.9
25 - 39	Very Good	96.0 – 97.4
40 and over	Excellent	97.5 or more

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Measurement of fabric density and weight: Fabric density means the ends per inch along the length and picks per inch along width measured according to ASTM D3775 - 17e1. Fabric GSM measured according to ASTM D3776M - 09a (2017).

III. Result and Discussion

The value of UPF increases with the increasing fabric density and weight for similar composition. To inspect the relationship between UPF, weight, composition, color and density, two approaches used here. One is investigating the change of UPF having same construction on different composition and another one is an identical composition having a different construction.

Table 2: Relationship of UPF with fabric density, composition, color and weight

Composition	GSM	EPI*PPI	Color	UPF
100% cotton	130	132*72	Black	28
			Red	13
60% cotton 40% polyester	130	132*72	Black	35
			Red	17
100% cotton	160	144*80	Black	32
			Red	15
60% cotton 40% polyester	160	144*80	Black	41
			Red	22

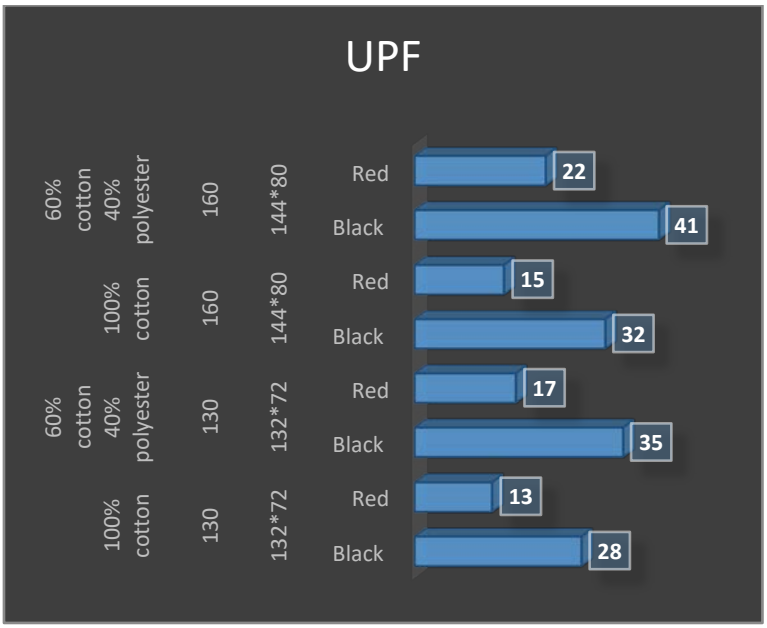

Figure 1: Relationship between color, weight and UPF rating.

As shown in figure 01, 100% cotton fabric has less UV protection power than the blended one. So polyester content in blended fabric enhances the UPF. Moreover, black color fabric has more UPF than red. Another finding of this study is the same color and identical composition fabric has different UPF because of different fabric density and weight. Higher the EPI and PPI values, higher the UPF value.

IV. Conclusion

This whole work is intended to establish a general idea on the issue of UV protection factor of a plain weave fabric simply. Considering fabric density, color and composition as main variables, UPF ratings are measured for different types of sample. UPF enhances with the increasing density, weight, the blended composition shows better value than the pure one, and black color shows excellent protection against UV. Though there are many other factors which can directly or indirectly influence the UV protection factor, here only a few represented. Also, establish a comparison among them. In addition, the most mentionable comparison is polyester has more UPF value than cotton.

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Potential Impacts of the Advent of Fully Autonomous Driving and Foreseeable Hindrances against Widespread Adoption of Robot Cars

By Mafolayomi Abiodun Oguntona, Bem Sombo & Silas Edwin Nduku
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Abstract- This publication brings to light the potential impacts of the advent of fully autonomous driving on the society in terms of positivities and otherwise. Almost every newly deployed technology has unintended downsides and consequences, this paper presents some of the prognosticated disadvantages of autonomous driving. It also explains the obstacles that might inhibit a widespread adoption of robotic vehicles/self-driving cars in the mainstream of driving, also making suggestions on how some of them can be surmounted. The study throws up some advantages of widespread adoption of self-driving cars such as improved mobility and safety, better traffic flow and environmental sustainability, efficient fuel and land use, increased human productivity and comfort; amongst other benefits.

Keywords: *autonomous driving, robot cars, self-driving vehicles, technology.*

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Potential Impacts of the Advent of Fully Autonomous Driving and Foreseeable Hindrances against Widespread Adoption of Robot Cars

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Abstract- This publication brings to light the potential impacts of the advent of fully autonomous driving on the society in terms of positivities and otherwise. Almost every newly deployed technology has unintended downsides and consequences, this paper presents some of the prognosticated disadvantages of autonomous driving. It also explains the obstacles that might inhibit a widespread adoption of robotic vehicles/self-driving cars in the mainstream of driving, also making suggestions on how some of them can be surmounted. The study throws up some advantages of widespread adoption of self-driving cars such as improved mobility and safety, better traffic flow and environmental sustainability, efficient fuel and land use, increased human productivity and comfort; amongst other benefits. It also details loss of jobs and privacy, cyber threats and security concerns, as well as reduced services and increased budgetary spending; as some of the potential downsides to a pervasive adoption of autonomous driving. While identifying human resistance, infrastructural and technological inadequacies, concerns of safety and affordability, as well as ethical and legal barriers; amongst other foreseeable inhibitions to the full scale deployment of autonomous vehicles.

Keywords: autonomous driving, robot cars, self-driving vehicles, technology.

I. INTRODUCTION

The phenomenon of autonomous vehicles/robot cars is one subject that arouses great interest and enthusiasm in people, our ears tingle whenever the phantom mechanism is being discussed. Many find it difficult to comprehend how machines will perform the complex, much attention-requiring and safety-critical chore of driving. But technically-oriented optimists know that this lofty aspiration is within reach. The world has waited for so long to see the day cars will be able to drive themselves, the hitherto seemingly grandiose idea has now dawned on mankind; autonomous driving is finally here and it is going to change everything!

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Autonomous vehicles or robot cars are intelligent agents that navigate themselves in road environments without human inputs, by taking in percepts on the current state of the world around them with the aid of highly advanced and sophisticated sensory systems. A fully autonomous vehicle can function without human control and does not require any human intervention. Autonomous vehicles can sense their local environment, classify different kinds of objects that they detect, can interpret sensory information to identify appropriate navigation paths whilst obeying transportation rules. They employ a different range of mechanisms to perceive their surroundings including radar, laser light, GPS, LIDAR; to mention but a few. Highly sophisticated control systems interpret sensory percepts so as to determine the most appropriate navigation routes, as well as obstacles, pedestrians, other agents and important traffic signs. They therefore must have control systems that are capable of interpreting sensory information to determine and distinguish between objects in their sight, with a view to making the right decision and taking the right course.

Autonomous cars have been something of a hot topic in recent years, with Google blazing the trail. Google has driven its fleet of experimental robot cars over millions of kilometers without serious incident. They have premiered amongst other inventions, a low-speed electric prototype to fine-tune city driving – with no steering wheel or brakes whatsoever. Outside Google; Toyota, Honda, and Ford all have their own self-driving car projects, although none of them are nearly as advanced as Google's. As a matter of fact, many automakers have dismissed the idea of fully autonomous cars out of hand as too challenging, focusing instead on Advanced Driver Assist features. Goggle, for its part has outlined an aggressive timeline to commercialization, hoping to partner with automakers to release autonomous vehicles, running Google software and manufactured by third parties before the close of the decade.

But to what extent will fully autonomous driving go mainstream upon its advent? What are the foreseeable impacts on our lives and society in general?

How well will it be accepted by consumers considering some genuine skeptical concerns of safety? Will all the current human-driven cars be eventually phased out like the typewriters of those days? Do we have the necessary key infrastructure to support self-driving cars? Will they be affordable? These are some of the questions agitating the minds of both the enthusiasts and skeptics alike of autonomous driving. These questions and perhaps some more must be answered for the world to fully berth on the shores of autonomous driving.

II. Potential Benefits of Widespread Adoption of Self-Driving Cars

Experts have predicted the advantageous impacts which the advent and eventual widespread adoption of robotic vehicle technologies will have on the society, businesses, and our way of life. Some of these potential benefits are discussed below:

Increased Mobility: A considerable percentage of the world's population is advertently or otherwise constrained from driving. Those who fall within this demography include: people who are disadvantaged in physicality as a result of advancement in age or disability, those who cannot have access to driver's permit as a result of statutory or monetary inadequacies, children and teenagers who are restricted by age; to mention but a few. Autonomous driving has one of the advantageous prospects of providing these groups with the means of independent mobility, will enable easier access to essential social services, and ultimately reduce their social isolation and give them a sense of societal belonging (Trommer, Kickhofer, Kuhnimof, Lenz & Phleps, 2016).

Improved Safety: Perhaps the most significant potential benefit of the full advent of autonomous driving is the promising prospect of reducing road crashes and ultimately improving safety. Statistics have it that nearly 1.2 million people die globally in car accidents every year, and 50,000 are maimed. It is also a widely held belief that over 90% of road crashes are caused by human errors. Car accidents have been largely attributed to human distractions while driving, drunk driving, overtaking miscalculations and impatience, recklessness and other aggressive driving behaviors. Advocates and experts therefore aver that since driver error contributes to more than 90% of traffic accidents, autonomous driving will reduce road mishaps by 90% (Litman, 2017).

Better Traffic Flow and Road Utilization: It is widely anticipated that autonomous driving will help better facilitate the concepts of ridesharing and platooning. Carpooling and ridesharing companies are set to leverage the potential possibilities of robot/self driving cars, with a view to promoting their businesses. It is expected that with the transition from manually driven cars to a widespread adoption of autonomous vehicles-based carpooling and ridesharing, there will be decreasing need to own a car, and as such the number of cars on roads is set to reduce, thereby promoting a better traffic. Autonomous vehicles are also expected to be able to travel closer together, engendering a better utilization of road capacity and dissipation of traffic congestions (Litman 2017; Trommer et al.).

Environmental Sustainability and Fuel Efficiency: With a widespread adoption of autonomous vehicles and the appurtenant improvement in traffic flow and reduction in the number of cars on roads, a decrease in energy/fuel consumption and hence resultant emission of harmful hydrocarbons into the atmosphere will naturally follow. Robotic cars are also expected to be able to accelerate and brake more smoothly than human drivers can do, thereby facilitating fuel efficiency (Trommer et al.). Add to this the fact that the future self-driving cars are set to exploit other sources of energies – such as electricity – which are more environmental-friendly, this will invariably reduce pollution. Lighter vehicles are also anticipated to come on board as road crashes reduce, thereby facilitating an improvement in the energy efficiency of the cars (Trommer et al.).

Land Use Efficiency: Another potential impact widespread adoption of autonomous vehicles will have on our geographical landscape is a reduction in the need for motorable roads and parking lots in highly developed and urban areas. In the US alone, about 5.7 billion square feet of land is dedicated to parking, and it is estimated that about 105 million parking spaces exist. It is instructive to add that most of these lots in big cities of the world are often superfluous. As robotic vehicles go mainstream and cars reduce on our roads, the redundant lands can be freed up for other uses such as, recreational parks, housing, retail and business outlets, and what have you. Additionally, car dealerships, mechanic workshops, gas stations, will all become reclaimed territories at the long run.

Better Human Productivity and Comfort: The behind-the-wheel commute time – especially for long distance trips – can be boring, physically demanding and strenuous. Add to this the fact that quality man hours are lost during driving in traffic and while embarking on long journeys. A wide spread adoption of self-driving cars will obviously address these issues. As prospective users travel in autonomous vehicles, they will have more time for work and rest. They can therefore choose to either channel gained time into productivity or relaxation. Moreover, travelers will enjoy more comfort as they are relieved of driving and navigational chores of steering and braking. Additionally, the increasing digitalization in modern vehicles and advancements in infotainment systems can improve the overall travel experience and comfort (Trommer et al.).

New Business Models: It is difficult to comprehensively and accurately predict the effects that the advent of autonomous vehicles will have on businesses, but one can make a shrewd conjecture of events to come. To start with, the phenomenon of self-driving greatly supports ride sharing, mobility service businesses are set to exploit this. Contemporary liability ordinances will definitely give way for new ones, with the full advent of robotic cars and car sharing. This will surely engender a resultant effect on insurance businesses as new models must be conceptualized to address the "disruptions". As driving becomes more enjoyable and travel time more interesting, air tourism will predictably take a hit as enterprising minds will capitalize on the prospects of land tourism in transit. There will be appurtenant startups to cater to the needs of the nascent self-driving car industry.

Vehicle Cost Savings: A widespread adoption of autonomous vehicles and car sharing platforms will encourage different mobility services to start up as explained previously. These services will tend to progressively discourage individual car ownership, as on the one hand robotic cars might not come readily affordable, and then on the other it is often more economical to patronize commercial transport services. This potential development will help predictably free up scarce resources from savings made that might have been expended on car purchase. Not to mention pecuniary endeavors appurtenant to private vehicle ownership like car insurance premium, fuelling, repairs, maintenance, parking fee, road and similar transport facilities tolls, and other sundry financial undertakings.

III. Potential Downsides to the Advent of Self-Driving Cars

Almost every newly deployed technology has unintended consequences. The robotic vehicle technology certainly will not be an exception. A conjecture of the possible undesirable fallouts of the widespread deployment of autonomous driving/robotic cars has been made. Some of the identified potential disadvantages are discussed below:

Loss of Jobs: The impact of the advent of fully autonomous vehicles on global economy and businesses will go both ways in terms of pros and cons. We cannot categorically say yet which one would outweigh the other, but these impacts are likely going to be monumental. The major predictable downside to the widespread adoption of robotic cars on economic activities is the loss of driving-related jobs. Several markets will be disrupted as services appurtenant to human-driven cars will likely reduce or go obsolete (Wikipedia; Schoitsch, 2016). Human taxi drivers will vehemently oppose this as the prognosis is not promising for them. Auto repairers should also feel threatened as there may be less demand for vehicle repairs due to reduced rate of road crashes (Litman, 2017). The entire public transport system will change and workers will become redundant. "Automated cars on demand" will replace bus lines in sparsely populated areas, and traffic police and other transport officials will become surplus to requirements (Schoitsch, 2016).

Probable Loss of Privacy: The robotic vehicle will be a highly automated and autonomous system. It will predictably be predicated on very sophisticated and virile network connections. The advent of self-driving cars is expected to come with vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications, with a view to facilitating efficiency and safety on the road ahead. These functions will be IP-based and therefore user's activities can be monitored, effectively culminating in privacy intrusion (Schoitsch, 2016). People have particularly expressed their skepticisms about the Google prototype self-driving car, many are of the opinion that riding with Google will be tantamount to riding with big brother! They believe features like GPS tracking and data sharing will leave them under the continuous surveillance of the search engine giant.

Cyber Threats and Security Concerns: Inextricably intertwined to loss of privacy and even more serious fallout of IP-based functions is the threat of cyber crimes and other serious concerns. The very latest cars of these days are often either connected or highly automated, and therefore have multiple access points which can be controlled from outside, having serious safety and security implications (Schoitsch, 2016). Criminal elements may access these network-based autonomous vehicles via hacking, with a view to perpetrating theft or other more serious malicious intentions. For example, terrorists can potentially use self-driving cars in deploying explosives for insurgent attacks (Litman, 2017). The vulnerability of highly connected and automated car systems to cyber abuse (hacking) has been demonstrated in a number of examples. A 2015 article on "Wired" written by Andy Greenburg and titled, "Hackers remotely kill jeep on the highway – with me in it," sufficiently demonstrates the potency of car hacking (Schoitsch, 2016).

Astronomical Costs: While the progressive costs of fabricating robotic cars cannot yet be ascertained, they most likely will not come cheap (Litman, 2017). Most of the highly sophisticated components that will be needed in producing autonomous vehicles like cameras, sensors, and other percepts-gathering devices cost thousands of dollars. The LIDAR turret for example, which is the primary sensing element of a certain Google's prototype, costs more than $30,000. Self-driving cars retail prices will certainly reflect these additional costs, as manufacturers will be expected to maintain a reasonable profit margin in production. But we can expect that as autonomous driving goes mainstream, there will be a mass production of some of

these expensive components and robotic cars themselves, which will predictably drive down costs at the long run.

Additional Risks: As exciting as the prospects of fully autonomous vehicles may be, they will also come with some additional risks. The most legitimate one being system failure which may engender what has been referred to as "death by computer". The robot car is an intelligent agent in its own right, a highly automated computer you might want to call it, there is therefore the plausible risk of it crashing, consequences of which can be cataclysmic. Another real risk associated with self-driving cars is the unreliability of sensing elements, especially under some unfavourable weather conditions. All of these pose a new threat to safety, as well as technological inadequacies in dealing with complex and uncertain situations. The unfortunate Tesla incident which happened in Autopilot mode corroborates this point. It claimed the life of the human driver who was aboard and did not intervene quickly upon a technological failure in percepts sensing (Schoitsch, 2016).

Increased Budgetary Spending and Misplaced Priority: It has already been established that for autonomous driving to gain widespread adoption and for the "smart" robotic vehicles to fully fulfill their potentials, we must put in place "smart" road equipment and facilities. There will be constant communications between the self-driving cars and the "smart" critical infrastructure. Many of such state-of-the-art facilities will not just be novel, but will also be very expensive. Therefore the execution of such requisite projects will incur humungous funds, and as such has the potential of increasing government's statutory spending exponentially. In the face of very limited government revenue, and many other programmes and services competing for budgetary allocations, investing in these autonomous driving infrastructure will take its toll on existing plans, and therefore might be seen as an imprudent move and a misplaced priority.

Reduced Services: Another foreseeable downside to the advent of fully autonomous driving is the issue of reduced services. While it has been argued that the widespread adoption of robotic vehicles will give a certain demography of the human population a sense of societal belonging, mainly those inhibited in terms of physicality like the senior citizens, those with health challenges and the physically challenged; the full scale deployment of robotic cars will also on the flip side take a serious toll on the same class of people. There are several very important services that human drivers do render for these people, like supporting them as they walk to get on human-driven cars, and likewise aiding them to alight at their desired destinations, not to mention often helping them in carrying their stuffs on and off the vehicles; these key services will obviously be negated the moment cars begin to drive themselves in a widespread dimension (Litman, 2017).

Induced Frustration and other Social Concerns: It is virtually impossible for computer science and artificial intelligence to cover all probable nuances and scenarios that might come up in driving. This technological inadequacy will make self-driving cars behave strangely and indiscretionally in certain situations, thus inducing frustration and aggression in human drivers. For example, if a robot car was driving along a highway and it perceived a tree branch poking outward from the bush, because it might not want to flout the traffic law of not crossing a double yellow line, it might come to a full stop instead of simply maneuvering around it. This kind of timid driving would surely irk human drivers behind and might even lead to a collision. There are also concerns that self-driving cars will be taken advantage of and bullied by human drivers, knowing full well that the robots will be programmed to drive conservatively and fully comply with traffic rules and regulations. This may somehow promote reckless driving from humans. Additionally, the culture of drinking might be encouraged, as humans will no longer have to worry about drunk-driving since robot cars now exist that can fully drive them home or wherever safely.

IV. Potential Obstacles to Widespread Adoption of Self-Driving Cars

Several factors have been identified as potential inhibitions to widespread adoption of autonomous driving technology. Some of them are comprehensively discussed below:

Safety/Privacy Concerns: Self-driving/autonomous vehicles are computers in their own right. They continually process percepts taken in with their sensors, and in turn generate appropriate actions on their surrounding environment. They do not exist in isolation; they must share information with themselves and the enabling smart infrastructure around. These activities are anticipated to be internet network-based. This makes them potentially vulnerable to malicious and ill-intentioned attacks. Simulation car hack demonstrated by Andy Greenburg corroborates this possibility (Schoitsch, 2016). Consider also the phenomenon of "death by computer". If computer systems can crash suddenly then there is a likelihood of a smart robotic vehicle having a system failure. There are also concerns about the potential loss of privacy which the highly sophisticated car-to-car, and car-to-infrastructure connections might bring. All of these might discourage full scale adoption of robotic vehicle technology.

Huge Infrastructure Deficit: For the phenomenon of autonomous driving to go widespread, we will need to re-design and re-engineer our current road infrastructure. As explained earlier, fully autonomous

vehicles are anticipated to be able to exhibit vehicle-to-vehicle, as well as vehicle-to-road facilities communications. If smart autonomous cars are going to fully takeover, our roads must also become smart. This will most certainly incur humongous funds to implement. Already national governments the world all over have other priority items competing for budgetary expenditures. An investment in these smart road facilities might be seen as misplacement of priority. This will not only inhibit the potentials of these self-driving cars to fully express themselves, but also hinder their widespread adoption.

Affordability: Autonomous vehicles will most likely not come cheap, although the incremental costs of manufacturing them are not yet verifiable. They incorporate features like highly sophisticated sensors, computers, and controls; amongst others. These additional vehicle equipment and parts cost tens of thousands of dollars. Also, given that the self-driving cars are safety-critical; these parts must meet very high standards of manufacturing, installation, testing, repair, and maintenance; as aircraft components. As such, robotic vehicle appurtenant parts will most likely be very expensive. This will resultantly have an effect on the overall cost of the vehicle. Vehicular services like repairs and maintenance will expectedly be higher than what currently obtains because of the additional sophistication. These envisaged incremental costs might discourage the purchase of autonomous vehicles and therefore pose as an inhibition against the transition from human driving to widespread autonomous driving.

Human Resistance: Resistance to the widespread adoption of autonomous vehicles should also be expected from the segment of the human population constituting people who either like driving or whose source of livelihood depends on it. A considerable percentage of the human population enjoys driving as a hobby, especially over long distances. Such might be unwilling to relinquish steering wheel controls to the vehicle. Also worth considering are driving-related jobs and services. Human taxi drivers and other commercial transport workers will certainly not be looking forward to the advent of robotic vehicles. They will surely oppose it as they now do with Uber; akin to the manner the advent of the railways was initially resisted by coachmen (Schoitsch, 2016).

Legal Framework: Another potential barrier to widespread adoption of self-driving vehicles is statutory inhibition. Some governments in the world might be unwilling to promulgate laws that support autonomous driving. This might be engendered by skepticisms about the safety and guarantee of user privacy in robotic vehicles. For example, some states in the US still do not allow the testing of self-driving vehicles on their roads due to different reasons but most commonly safety. If these automated intelligent vehicles are to go mainstream of driving, national and state governments must first make laws that permit testing, and thereafter eventual use by the public. The sheer robustness of the necessary legal framework might be an encumbrance; as several issues like liability and ethics must be factored in. And then in the highly litigious nations of the world, one can still expect an opposition to these statutory implementations.

Technological Inadequacy: The available stock of autonomous vehicles is not yet perfect. Some of them still require a human driver to be present and alert with a view to taking over in dicey situations. A good number of these self-driving cars function sub-optimal under unfavourable weather conditions. Flash flooding, heavy fog, and deep snow, amongst other natural phenomena; are known to seriously affect the performance of autonomous vehicles' sensing components. Then there is the issue of insufficient adaptation to the gestures and non verbal communications of pedestrians, and dealing with stray animals on the road. Until equipments that can work under any harsh condition are manufactured and algorithms further fine-tuned to address different scenarios that might come up in driving, skepticisms will still be there about the safety and efficiency of the robotic vehicles. As such, the bulk of the general public might be reluctant to jump on the bandwagon of autonomous driving.

Ethics and Liability: The most talked about barriers when analyzing the feasibility of a world filled with self-driving cars are infrastructural and technological inadequacies. But then the twin grey areas of ethics and liability need to be comprehensively discussed and ironed out before the robotic driving technology can fully take off. Some inevitable situations often arise in driving when the human driver has to choose between two or more undesirable outcomes, thereby ensuring the minimal possible damage, how will the inanimate robot car deal with this situation? Conventional rules in human driving have it that the person behind the wheels is fully responsible, and therefore is liable for prosecution in the event of a culpable mishap. But who is going to be responsible when a self-driving car gets involved in a pedestrian-killing incident, the owner of the robot car or the manufacturer? The debate on this still goes on. These thorny issues must be sorted out first with a view to establishing a robust and viable legal framework that enables fully autonomous driving in our society (Schoitsch, 2016).

V. Conclusion and Recommendation

We cannot accurately predict what a future of fully autonomous driving holds for us. We can only make a shrewd conjecture of how a world filled with robot cars will look like. But it is safe to say that its full advent and widespread adoption will monumentally change

transportation, businesses, and in general our way of life.

The currently obtainable stock of self-driving cars is not perfect. The first step that must perhaps be taken in the journey to the future of fully autonomous driving is the promulgation of laws that support the testing of autonomous vehicles on our roads, and removal of legal barriers against such. The Vienna and Geneva treaties certainly must be reviewed. This is necessary with a view to improving on what has been achieved so far in autonomous driving technology.

It goes without saying that government at all levels must invest massively in road infrastructure. The decrepit and deplorable roads still obtainable in developing and underdeveloped nations of the world must give way to fantastically motorable roads. Robot cars will never be able to truly fulfill their potentials without impeccable road facilities.

Internet, which will be central to vehicle-to-vehicle and vehicle-to-infrastructure communications in robotic driving technology, must be deployed widely and in excellent strength.

Artificial intelligence programmers must fine-tune their algorithms to adequately cover every nuance and possible scenario that might come up in driving. Similarly, better and more efficient robotic driving-supporting technologies must evolve, especially in the area of percepts sensing. This is imperative with a view to addressing the current technological inadequacies, thereby alleviating the fears and skepticisms of the general public about the safety and other issues pertaining to self-driving cars.

However, given the inhibitions we identified in this report, we still feel that the future of widespread robotic driving might not come earlier than fifty years from now.

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Effect of Scouring and Bleaching Agents on Whiteness Index and Bursting Strength of Cotton Knitted Fabric

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Abstract- This paper shows the effect of different bleaching agent on whiteness index and bursting strength of the cotton knitted fabric. Bleaching process uses three types of bleaching agents namely hydrogen peroxide (H_2O_2), sodium hypochlorite (NaOCl) and calcium hypochlorite $Ca(OCl)_2$ with varying their concentration and these are 1.5 g/l, 2.5 g/l, 3.5 g/l, 4.5 g/l, and 5.5 g/l. In the same time, scouring agent was caustic soda, and its concentration for all the bleaching agents was same. It is obvious that with the increase of bleaching agent concentration, whiteness index increases, and bursting strength reduces.

Keywords: bleaching agents, cotton knitted fabric, whiteness index, bursting strength, concentration.

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Effect of Scouring and Bleaching Agents on Whiteness Index and Bursting Strength of Cotton Knitted Fabric

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Abstract- **This paper shows the effect of different bleaching agent on whiteness index and bursting strength of the cotton knitted fabric. Bleaching process uses three types of bleaching agents namely hydrogen peroxide (H_2O_2), sodium hypochlorite (NaOCl) and calcium hypochlorite $Ca(OCl)_2$ with varying their concentration and these are 1.5 g/l, 2.5 g/l, 3.5 g/l, 4.5 g/l, and 5.5 g/l. In the same time, scouring agent was caustic soda, and its concentration for all the bleaching agents was same. It is obvious that with the increase of bleaching agent concentration, whiteness index increases, and bursting strength reduces.**

Keywords: bleaching agents, cotton knitted fabric, whiteness index, bursting strength, concentration.

I. Introduction

Pretreatment of textile materials is very important, without pretreatment the coloration of cotton is nearly impossible to get the desired result. For the achievement of optimum whiteness, the removing of natural color from the grey cotton fabric is a must. S. M. F. Kabir *et al* shows in their study that the whiteness of cotton increases with the use of blue or optical brightening agents [1]. But there may arise some problems in case of further coloration process because blue or optical brightening agents can affect the shade of the dyed fabric.

Generally scouring removes all impurities except the natural coloring matters which have to be broken down by bleaching agent either with an oxidizing or reducing agent. When the color acts upon by reducing agent, there is always the possibility that the oxygen in the air may deoxidize it to its original color [2].

There are different bleaching agents for this purpose; most of them are oxidative. S. Polat *et al*. shows in their investigation, the amount of hydrogen peroxide has a great effect on the whiteness of cotton knitted fabric [3].

Saravanan et al. study on the bleaching effect of cotton fabrics shows that by using hydrogen peroxide, which is from glucose oxidase enzyme, shows lower whiteness values than the expectation of the commercial processes [4]. Kumbasar *et al.* investigation on hydrophilicity and whiteness index shows that with the increase of hydrogen peroxide and activator concentration, hydrophilicity and whiteness increase also increase [5]. With the perfect bleaching of cotton fabric, some weight loss of cotton fabric will happen. Abdul and Narendra found that in their study, with the increase in concentration of bleaching agent, whiteness index increases but the weight of material decreases [6]. In the case of weight loss, there may be an effect of bursting strength of cotton fabrics.

For the achievement of optimum whiteness index there may be loss of weight of the cotton fabric, Naser *et al.* try to optimize bleaching parameters for whiteness index and bursting strength of the knitted cotton fabric, they observe an inverse relation between themselves [7].

II. Materials and Methods

a) Materials

100% cotton knitted single jersey (160 GSM) and hydrogen peroxide (H_2O_2), sodium hypochlorite (NaOCl) and calcium hypochlorite $Ca(OCl)_2$ were used as bleaching agents and sodium hydroxide as a scouring agent.

b) Work outline

Collection of Grey Fabric
↓
Scouring and bleaching
↓
Whiteness Test (By Using Spectrophotometer)
↓
Bursting strength Test (By Using Bursting Strength Tester)
↓
Result and Discussion

c) Scouring & Bleaching Recipe

Different bleaching agents at different concentration were used in this research paper for investigation of whiteness index and bursting strength of 100% cotton knitted single jersey.

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Table 1: Bleaching by Hydrogen Peroxide (H_2O_2)

Sample No.	Hydrogen Peroxide (H_2O_2)	Sodium Hydroxide (NaOH)	Temperature	Time	M:L
1	1.5 g/l	1 g/l	98^0 C	30 min	1:10
2	2.5 g/l	2 g/l			
3	3.5 g/l	3 g/l			
4	4.5 g/l	4 g/l			
5	5.5 g/l	5 g/l			

Table 2: Bleaching by Sodium Hypochlorite NaOCl

Sample No.	Sodium Hypochlorite NaOCl	Sodium Hydroxide(NaOH)	Temperature	Time	M:L
6	1.5 g/l	1 g/l	60^0 C	50 min	1:10
7	2.5 g/l	2 g/l			
8	3.5 g/l	3 g/l			
9	4.5 g/l	4 g/l			
10	5.5 g/l	5 g/l			

Table 3: Bleaching by Calcium Hypochlorite $Ca(OCl)_2$

Sample No.	Calcium Hypochlorite $Ca(OCl)_2$	Sodium Hydroxide (NaOH)	Temperature	Time	M:L
11	1.5	1 g/l	60^0 C	50 min	1:10
12	2.5	2 g/l			
13	3.5	3 g/l			
14	4.5	4 g/l			
15	5.5	5 g/l			

d) Process curve for Hydrogen Peroxide (H_2O_2)

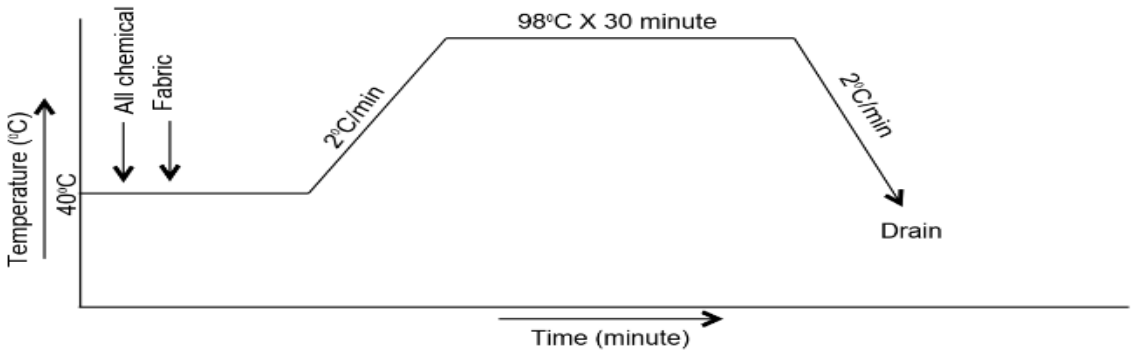

Figure 1: Bleaching process curve for Hydrogen Peroxide (H_2O_2)

e) Process curve for Sodium Hypochlorite(NaOCl)

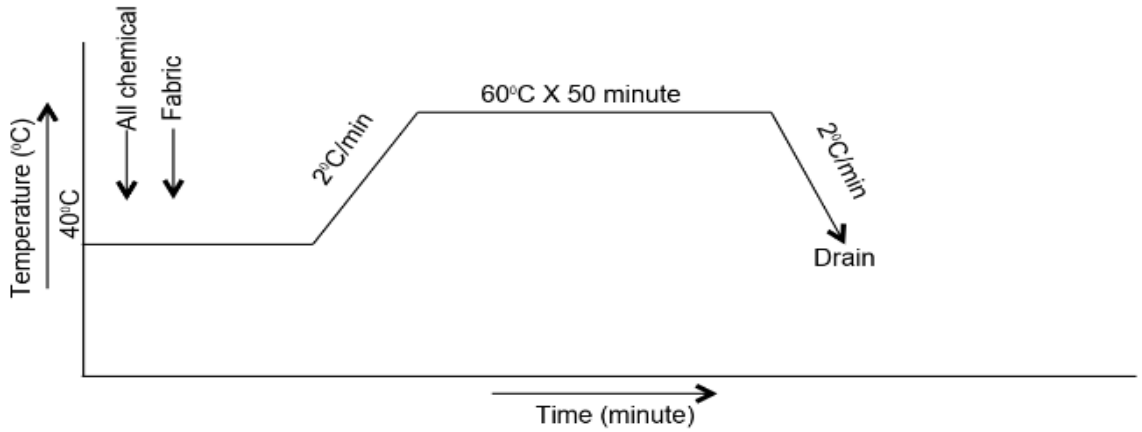

Figure 2: Bleaching Process curve for Sodium Hypochlorite (NaOCl)

f) Process curve for Calcium Hypo chlorite $Ca(OCl)_2$

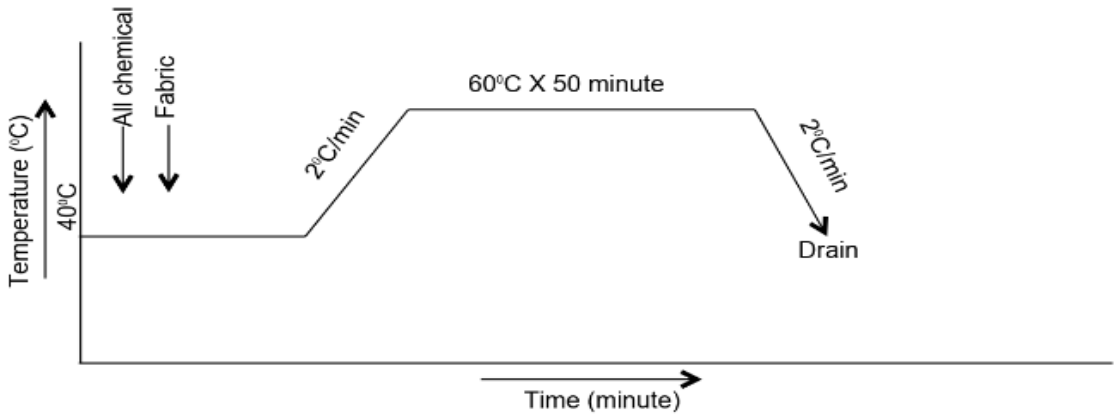

Figure 3: Bleaching Process curve for calcium Hypochlorite ($Ca(OCl)_2$)

g) Measurement of whiteness Index

Whiteness index of the scoured and bleached sample was determined by the reflectance value of spectrophotometer (Datacolor650) at 10^0 observer and D65 illuminant.

h) Measurement of Bursting Strength Test

Pneumatic method (ISO 13938-2: 1999) was used for the determination of bursting strength and bursting properties of the samples [8].

III. Result & Discussions

a) Effect of hydrogen peroxide (H_20_2)on whiteness

The whiteness index of the sample increases with the increase of peroxide concentration markedly upto 4.5 g/l. Further increasing of hydrogen peroxide does not play a significant role in increasing whiteness index, and 4.5 g/l is the optimum concentration.

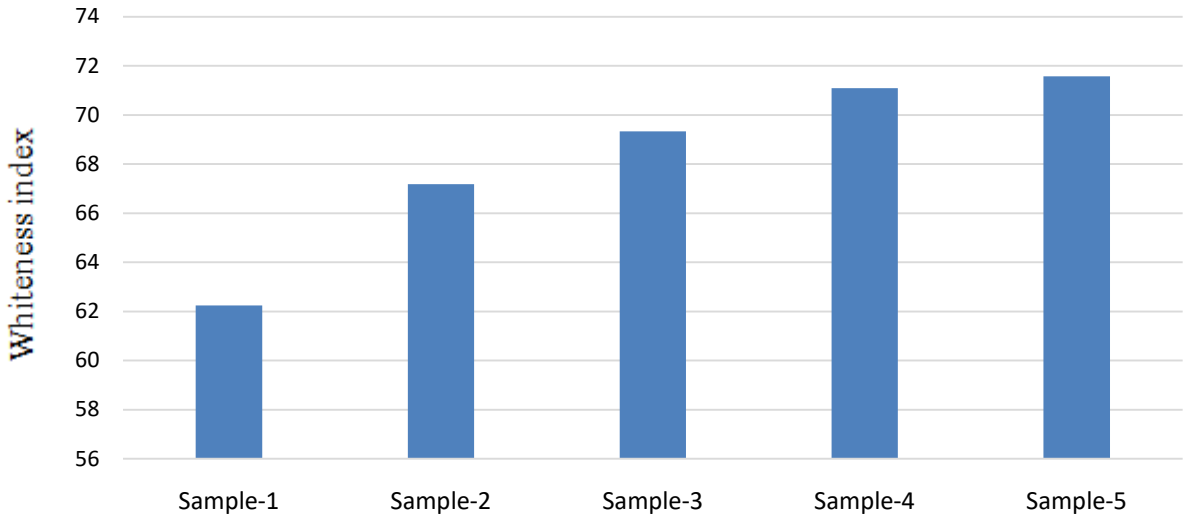

Figure 4: Effect of hydrogen peroxide (H_20_2) on whiteness index

b) Effect of hydrogen peroxide (H_20_2) on bursting strength

Following graph shows the effect of hydrogen peroxide concentration on the bursting strength and it seems that 3.5 g/l has a moderate effect on the strength of the fabric.

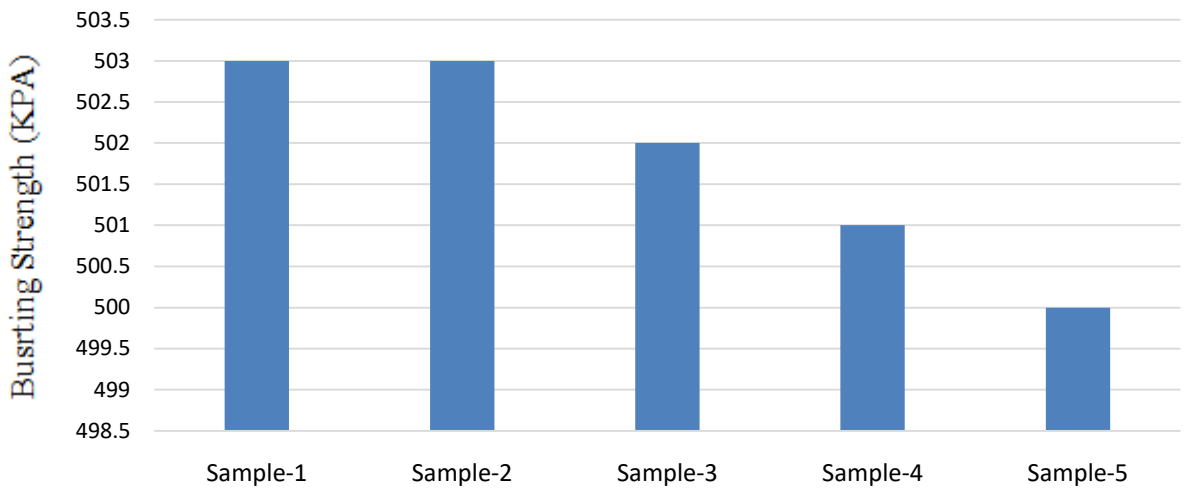

Figure 5: Effect of hydrogen peroxide (H_20_2) on bursting strength

c) *Effect of Sodium Hypochlorite (NaOCl)on whiteness*

From figure 6, it is clear that for increasing concentration of sodium hypochlorite, whiteness index increases.

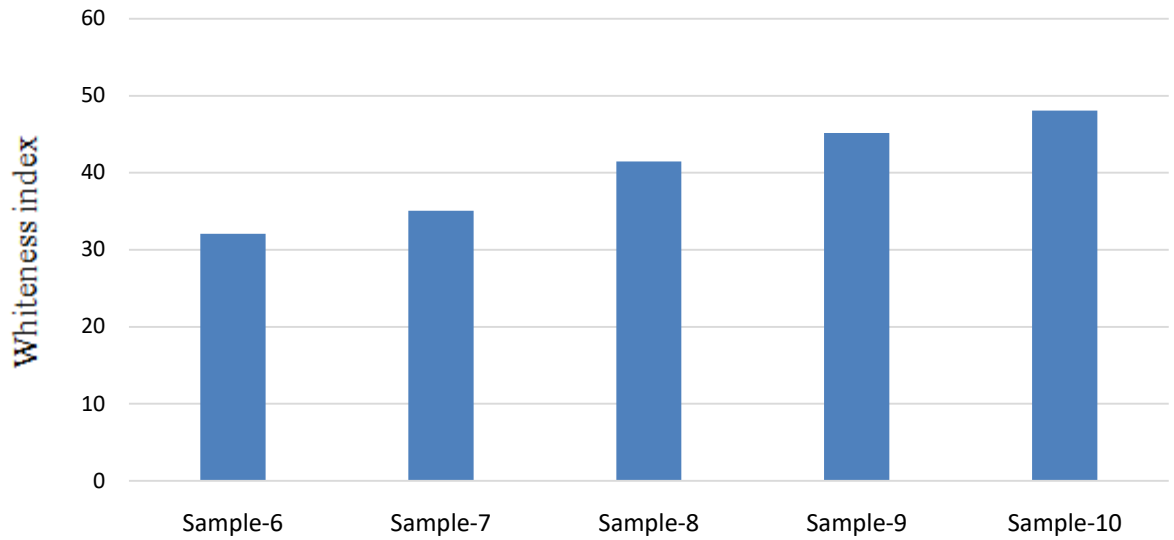

Figure 6: Effect of Sodium Hypochlorite (NaOCl) on whiteness

d) *Effect of Sodium Hypochlorite (NaOCl) on bursting strength*

Figure 7 shows that the bursting strength of the samples are almost same.

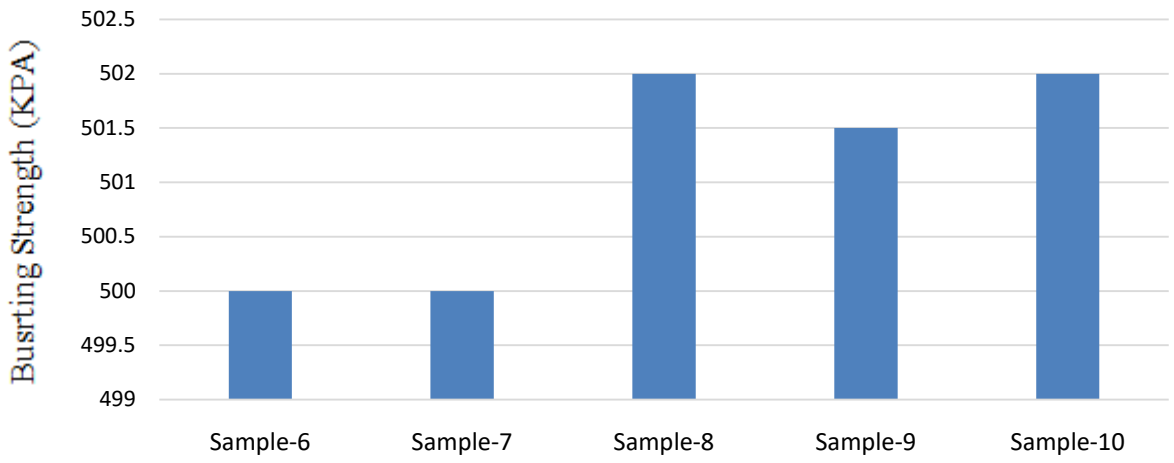

Figure 7: Effect of Sodium Hypochlorite (NaOCl) on bursting strength

e) Effect of Calcium Hypochlorite $Ca(OCl)_2$ on whiteness

It is found that for increasing concentration of calcium hypochlorite, whiteness index is increased.

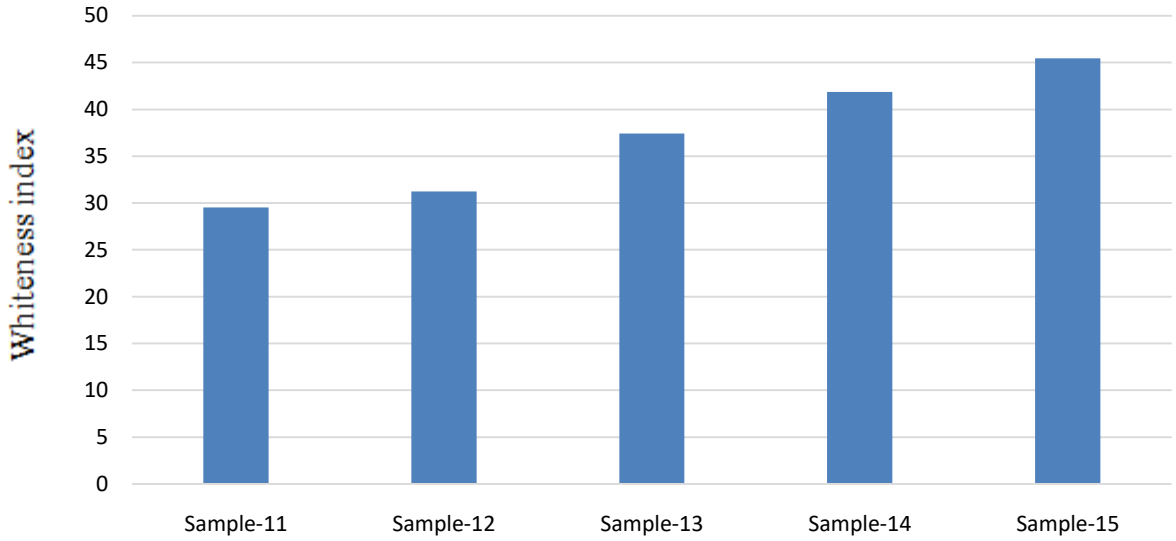

Figure 8: Effect of Calcium Hypochlorite $Ca(OCl)_2$ on whiteness

f) Effect of Calcium Hypochlorite $Ca(OCl)_2$ on bursting strength

The graph shows that for the higher concentration of calcium hypochlorite, bursting strength was less. At a concentration of 3.5g/l to 5.5g/l of Calcium Hypochlorite $Ca(OCl)_2$ bursting strength are same.

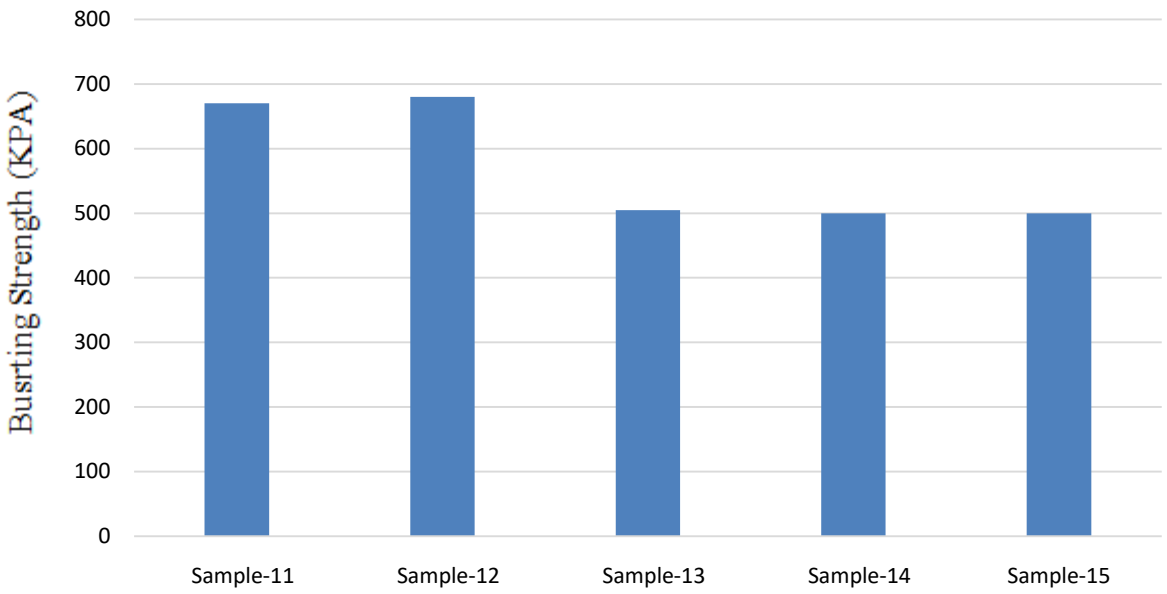

Figure 9: Effect of Calcium Hypochlorite $Ca(OCl)_2$ on bursting strength

IV. Conclusion

With the increase of the concentration of Hydrogen peroxide (H_2O_2), Sodium Hypochlorite (NaOCl), and Calcium Hypochlorite $Ca(OCl)_2$, there is a significant improvement in the whiteness index of the bleached cotton fabric. When the concentration of Hydrogen peroxide (H_2O_2), Sodium Hypochlorite (NaOCl) Calcium Hypochlorite $Ca(OCl)_2$ was over 3.5 g/l, there was no remarkable change in whiteness. However, 4g/l concentration for Hydrogen peroxide (H_2O_2), and 3.5 g/l for Sodium Hypochlorite (NaOCl), and Calcium Hypochlorite $Ca(OCl)_2$, are the optimum concentration for suitable bleaching because though further increase in concentration, increases whiteness index but bursting strength of the cotton fabrics decreases due to hydrolyzation of cellulose.

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Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

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Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Engineering Research Paper

Techniques for writing a good quality engineering research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of research engineering then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.

- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

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