| **EDITORIAL BOARD** |
| **GLOBAL JOURNAL OF RESEARCH IN ENGINEERING** |

<table>
<thead>
<tr>
<th><strong>Dr. Ren-Jye Dzeng</strong></th>
<th><strong>Dr. Eric M. Lui</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor</td>
<td>Ph.D.,</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>Structural Engineering</td>
</tr>
<tr>
<td>National Chiao-Tung University</td>
<td>Department of Civil</td>
</tr>
<tr>
<td>Taiwan</td>
<td>&amp; Environmental Engineering</td>
</tr>
<tr>
<td>Dean of General Affairs</td>
<td>Syracuse University, USA</td>
</tr>
<tr>
<td>Ph.D., Civil &amp; Environmental Engineering</td>
<td></td>
</tr>
<tr>
<td>University of Michigan, USA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Ephraim Suhir</strong></th>
<th><strong>Dr. Zhou Yufeng</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D., Dept. of Mechanics and Mathematics, Moscow University</td>
<td>Ph.D. Mechanical Engineering &amp; Materials Science, Duke University, US</td>
</tr>
<tr>
<td>Moscow, Russia</td>
<td>Assistant Professor College of Engineering, Nanyang Technological University, Singapore</td>
</tr>
<tr>
<td>Bell Laboratories</td>
<td></td>
</tr>
<tr>
<td>Physical Sciences and Engineering Research Division, USA</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Pangil Choi</strong></th>
<th><strong>Dr. Pallav Purohit</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D.</td>
<td>Ph.D. Energy Policy and Planning</td>
</tr>
<tr>
<td>Department of Civil, Environmental, and Construction Engineering</td>
<td>Indian Institute of Technology (IIT), Delhi</td>
</tr>
<tr>
<td>Texas Tech University, US</td>
<td>Research Scientist, International Institute for Applied Systems Analysis (IIASA), Austria</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Iman Hajirasouliha</strong></th>
<th><strong>Dr. Zi Chen</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D. in Structural Engineering</td>
<td>Ph.D. Department of Mechanical &amp; Aerospace Engineering, Princeton University, US</td>
</tr>
<tr>
<td>Associate Professor, Department of Civil and Structural Engineering, University of Sheffield, UK</td>
<td>Assistant Professor, Thayer School of Engineering, Dartmouth College, Hanover, US</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Wenfang Xie</strong></th>
<th><strong>Dr. Giacomo Risitano</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D., Department of Electrical Engineering, Hong Kong Polytechnic University, Department of Automatic Control, Beijing University of Aeronautics and Astronautics, China</td>
<td>Ph.D., Industrial Engineering at University of Perugia (Italy)</td>
</tr>
<tr>
<td>&quot;Automotive Design&quot; at Engineering Department of Messina University (Messina) Italy.</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Institution and Position</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Dr. Joaquim Carneiro</td>
<td>Ph.D. in Mechanical Engineering, Faculty of Engineering, University of Porto (FEUP), University of Minho, Department of Physics, Portugal</td>
</tr>
<tr>
<td>Dr. Maurizio Palesi</td>
<td>Ph.D. in Computer Engineering, University of Catania, Faculty of Engineering and Architecture, Italy</td>
</tr>
<tr>
<td>Dr. Hai-Wen Li</td>
<td>Ph.D., Materials Engineering, Kyushu University, Fukuoka, Guest Professor at Aarhus University, Japan</td>
</tr>
<tr>
<td>Dr. Cesar M. A. Vasques</td>
<td>Ph.D., Mechanical Engineering, Department of Mechanical Engineering, School of Engineering, Polytechnic of Porto, Porto, Portugal</td>
</tr>
<tr>
<td>Dr. Wei-Hsin Chen</td>
<td>Ph.D., National Cheng Kung University, Department of Aeronautics and Astronautics, Taiwan</td>
</tr>
<tr>
<td>Dr. Stefano Invernizzi</td>
<td>Ph.D. in Structural Engineering, Technical University of Turin, Department of Structural, Geotechnical and Building Engineering, Italy</td>
</tr>
<tr>
<td>Dr. Saeed Chehreh Chelgani</td>
<td>Ph.D. in Mineral Processing, University of Western Ontario, Adjunct professor, Mining engineering and Mineral processing, University of Michigan</td>
</tr>
<tr>
<td>Belen Riveiro</td>
<td>Ph.D., School of Industrial Engineering, University of Vigo, Spain</td>
</tr>
<tr>
<td>Dr. T.S. Jang</td>
<td>Ph.D. in Naval Architecture and Ocean Engineering, Seoul National University, Korea, Director, Arctic Engineering Research Center, The Korea Ship and Offshore Research Institute, Pusan National University, South Korea</td>
</tr>
<tr>
<td>Dr. Jun Wang</td>
<td>Ph.D. in Architecture, University of Hong Kong, China, Urban Studies, City University of Hong Kong, China</td>
</tr>
<tr>
<td>Dr. Bin Chen</td>
<td>B.Sc., M.Sc., Ph.D., Xi’an Jiaotong University, China, State Key Laboratory of Multiphase Flow in Power Engineering, Xi’an Jiaotong University, China</td>
</tr>
<tr>
<td>Dr. Salvatore Brischetto</td>
<td>Ph.D. in Aerospace Engineering, Polytechnic University of Turin and in Mechanics, Paris West University Nanterre La Défense, Department of Mechanical and Aerospace Engineering, Polytechnic University of Turin, Italy</td>
</tr>
<tr>
<td>Name</td>
<td>Title and Institutions</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Dr. Francesco Tornabene</strong></td>
<td>Ph.D. in Structural Mechanics, University of Bologna</td>
</tr>
<tr>
<td></td>
<td>Professor Department of Civil, Chemical, Environmental and Materials Engineering</td>
</tr>
<tr>
<td></td>
<td>University of Bologna, Italy</td>
</tr>
<tr>
<td><strong>Dr. Wesam S. Alaloul</strong></td>
<td>B.Sc., M.Sc.,</td>
</tr>
<tr>
<td></td>
<td>Ph.D. in Civil and Environmental Engineering, University Technology Petronas, Malaysia</td>
</tr>
<tr>
<td><strong>Dr. Togay Ozbakkaloglu</strong></td>
<td>B.Sc. in Civil Engineering</td>
</tr>
<tr>
<td></td>
<td>Ph.D. in Structural Engineering, University of Ottawa, Canada</td>
</tr>
<tr>
<td></td>
<td>Senior Lecturer University of Adelaide, Australia</td>
</tr>
<tr>
<td><strong>Dr. Sofoklis S. Makridis</strong></td>
<td>B.Sc(Hons), M.Eng, Ph.D.</td>
</tr>
<tr>
<td></td>
<td>Professor Department of Mechanical Engineering, University of Western Macedonia, Greece</td>
</tr>
<tr>
<td><strong>Dr. Paolo Veronesi</strong></td>
<td>Ph.D., Materials Engineering</td>
</tr>
<tr>
<td></td>
<td>Institute of Electronics, Italy</td>
</tr>
<tr>
<td></td>
<td>President of the master Degree in Materials Engineering</td>
</tr>
<tr>
<td></td>
<td>Dept. of Engineering, Italy</td>
</tr>
<tr>
<td><strong>Dr. Maria Daniela</strong></td>
<td>Ph.D. in Aerospace Science and Technologies</td>
</tr>
<tr>
<td></td>
<td>Second University of Naples</td>
</tr>
<tr>
<td></td>
<td>Research Fellow University of Naples “Federico II”, Italy</td>
</tr>
<tr>
<td><strong>Dr. Charles-Darwin Annan</strong></td>
<td>Ph.D.,</td>
</tr>
<tr>
<td></td>
<td>Professor Civil and Water Engineering University Laval, Canada</td>
</tr>
<tr>
<td><strong>Dr. Ananda Kumar Palaniappan</strong></td>
<td>B.Sc., MBA, MED, Ph.D. in Civil and Environmental Engineering, Ph.D. University of Malaya, Malaysia</td>
</tr>
<tr>
<td><strong>Dr. Zhen Yuan</strong></td>
<td>B.E., Ph.D. in Mechanical Engineering</td>
</tr>
<tr>
<td></td>
<td>University of Sciences and Technology of China, China</td>
</tr>
<tr>
<td></td>
<td>Professor, Faculty of Health Sciences, University of Macau, China</td>
</tr>
<tr>
<td><strong>Dr. Hugo Silva</strong></td>
<td>Associate Professor</td>
</tr>
<tr>
<td></td>
<td>University of Minho</td>
</tr>
<tr>
<td></td>
<td>Department of Civil Engineering</td>
</tr>
<tr>
<td></td>
<td>Ph.D., Civil Engineering</td>
</tr>
<tr>
<td></td>
<td>University of Minho, Portugal</td>
</tr>
<tr>
<td><strong>Dr. Stefano Mariani</strong></td>
<td>Associate Professor</td>
</tr>
<tr>
<td></td>
<td>Structural Mechanics</td>
</tr>
<tr>
<td></td>
<td>Department of Civil and Environmental Engineering, Ph.D., in Structural Engineering</td>
</tr>
<tr>
<td></td>
<td>Polytechnic University of Milan, Italy</td>
</tr>
<tr>
<td><strong>Dr. Jui-Sheng Chou</strong></td>
<td>Ph.D. University of Texas at Austin, U.S.A.</td>
</tr>
<tr>
<td></td>
<td>Department of Civil and Construction Engineering, National Taiwan University of Science and Technology (Taiwan Tech)</td>
</tr>
<tr>
<td>Name</td>
<td>Position/Institution</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| **Dr. Shaoping Xiao** | BS, MS  
Ph.D. Mechanical Engineering, Northwestern University  
The University of Iowa  
Department of Mechanical and Industrial Engineering  
Center for Computer-Aided Design |
| **Dr. Fausto Gallucci** | Associate Professor  
Chemical Process Intensification (SPI)  
Faculty of Chemical Engineering and Chemistry  
Assistant Editor  
International J. Hydrogen Energy, Netherlands |
| **Dr. Vladimir Gurao** | Associate Professor  
Ph.D. in Mechanical / Aerospace Engineering  
University of Miami  
Engineering Technology |
| **Prof. (LU) Prof. (UoS) Dr. Miklas Scholz** | Cand Ing, BEng (equiv), PgC, MSc, Ph.D., CWEM, CEnv, CSci, CEng, FHEA, FIEMA, FCIWEM, FICE, Fellow of IWA, VINNOVA Fellow, Marie Curie Senior Fellow, Chair in Civil Engineering (UoS)  
Wetland systems, sustainable drainage, and water quality |
| **Dr. Adel Al Jumaily** | Ph.D. Electrical Engineering (AI)  
Faculty of Engineering and IT  
University of Technology, Sydney |
| **Dr. Houfa Shen** | Ph.D. Manufacturing Engineering, Mechanical Engineering, Structural Engineering  
Department of Mechanical Engineering  
Tsinghua University, China |
| **Dr. A. Stegou-Sagia** | Ph.D. Mechanical Engineering, Environmental Engineering School of Mechanical Engineering  
National Technical University of Athens |
| **Dr. Kitipong Jaojaruek** | B. Eng, M. Eng  
D. Eng (Energy Technology, Asian Institute of Technology).  
Kasetsart University Kamphaeng Saen (KPS) Campus  
Energy Research Laboratory of Mechanical Engineering |
| **Dr. Jalal Kafashan** | Mechanical Engineering  
Division of Mechatronics  
KU Leuven, BELGIUM |
| **Dr. Haijian Shi** | Ph.D. Civil Engineering  
Structural Engineering  
Oakland, CA, United States |
<table>
<thead>
<tr>
<th>Name</th>
<th>Title/Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Omid Gohardani</td>
<td>Ph.D. Senior Aerospace/Mechanical/Aeronautical Engineering professional</td>
</tr>
<tr>
<td></td>
<td>M.Sc. Mechanical Engineering</td>
</tr>
<tr>
<td></td>
<td>M.Sc. Aeronautical Engineering</td>
</tr>
<tr>
<td></td>
<td>B.Sc. Vehicle Engineering</td>
</tr>
<tr>
<td></td>
<td>Orange County, California, US</td>
</tr>
<tr>
<td>Dr. Burcin Becerik-Gerber</td>
<td>Ph.D. in Civil Engineering</td>
</tr>
<tr>
<td></td>
<td>DDes from Harvard University</td>
</tr>
<tr>
<td></td>
<td>M.S. from University of California, Berkeley</td>
</tr>
<tr>
<td></td>
<td>M.S. from Istanbul Technical University</td>
</tr>
<tr>
<td></td>
<td>Web: i-lab.usc.edu</td>
</tr>
<tr>
<td>Dr. Maciej Gucma</td>
<td>Asistant Professor, Maritime University of Szczecin</td>
</tr>
<tr>
<td></td>
<td>Szczecin, Poland</td>
</tr>
<tr>
<td></td>
<td>Ph.D., Eng. Master Mariner</td>
</tr>
<tr>
<td></td>
<td>Web: <a href="http://www.mendeley.com/profiles/maciej-gucma/">www.mendeley.com/profiles/maciej-gucma/</a></td>
</tr>
<tr>
<td>Dr. Ye Tian</td>
<td>Ph.D. Electrical Engineering</td>
</tr>
<tr>
<td></td>
<td>The Pennsylvania State University</td>
</tr>
<tr>
<td></td>
<td>121 Electrical Engineering East</td>
</tr>
<tr>
<td></td>
<td>University Park, PA 16802, US</td>
</tr>
<tr>
<td>Dr. Alex W. Dawotola</td>
<td>Hydraulic Engineering Section,</td>
</tr>
<tr>
<td></td>
<td>Delft University of Technology</td>
</tr>
<tr>
<td></td>
<td>Stevinweg, Delft, Netherlands</td>
</tr>
<tr>
<td>Dr. M. Meguellati</td>
<td>Department of Electronics,</td>
</tr>
<tr>
<td></td>
<td>University of Batna, Batna 05000, Algeria</td>
</tr>
<tr>
<td>Dr. Balasubramani R</td>
<td>Ph.D., (IT) in Faculty of Engg. &amp; Tech.</td>
</tr>
<tr>
<td></td>
<td>Professor &amp; Head, Dept. of ISE at NMAM Institute of Technology</td>
</tr>
<tr>
<td>Dr. Minghua He</td>
<td>Department of Civil Engineering</td>
</tr>
<tr>
<td></td>
<td>Tsinghua University</td>
</tr>
<tr>
<td></td>
<td>Beijing, 100084, China</td>
</tr>
<tr>
<td>Dr. Diego González-Aguilera</td>
<td>Ph.D. Dep. Cartographic and Land Engineering, University of Salamanca, Ávila, Spain</td>
</tr>
<tr>
<td>Dr. Fentahun Moges Kasie</td>
<td>Department of mechanical &amp; Industrial Engineering, Institute of technology</td>
</tr>
<tr>
<td></td>
<td>Hawassa University Hawassa, Ethiopia</td>
</tr>
<tr>
<td>Dr. Ciprian LĂPUȘAN</td>
<td>Ph. D in Mechanical Engineering</td>
</tr>
<tr>
<td></td>
<td>Technical University of Cluj-Napoca</td>
</tr>
<tr>
<td></td>
<td>Cluj-Napoca (Romania)</td>
</tr>
<tr>
<td>Dr. Zhibin Lin</td>
<td>Center for Infrastructure Engineering Studies</td>
</tr>
<tr>
<td></td>
<td>Missouri University of Science and Technology</td>
</tr>
<tr>
<td></td>
<td>ERL, 500 W. 16th St. Rolla,</td>
</tr>
<tr>
<td></td>
<td>Missouri 65409, US</td>
</tr>
<tr>
<td>Name</td>
<td>Title and Affiliations</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Dr. Shun-Chung Lee</strong></td>
<td>Department of Resources Engineering, National Cheng Kung University, Taiwan</td>
</tr>
<tr>
<td><strong>Hiroshi Sekimoto</strong></td>
<td>Professor Emeritus, Tokyo Institute of Technology, Japan, Ph.D., University of California, Berkeley</td>
</tr>
<tr>
<td><strong>Dr. Philip T Moore</strong></td>
<td>Ph.D., Graduate, Master Supervisor, School of Information, Science and engineering, Lanzhou University, China</td>
</tr>
<tr>
<td><strong>Dr. Steffen Lehmann</strong></td>
<td>Faculty of Creative and Cultural Industries, PhD, AA Dip, University of Portsmouth, UK</td>
</tr>
<tr>
<td><strong>Dr. Yudong Zhang</strong></td>
<td>B.S., M.S., Ph.D. Signal and Information Processing, Southeast University, Professor School of Information Science and Technology at Nanjing Normal University, China</td>
</tr>
<tr>
<td><strong>Dr. Xianbo Zhao</strong></td>
<td>Ph.D. Department of Building, National University of Singapore, Singapore, Senior Lecturer, Central Queensland University, Australia</td>
</tr>
<tr>
<td><strong>Dr. Philip G. Moscoso</strong></td>
<td>Technology and Operations Management, IESE Business School, University of Navarra, Ph.D in Industrial Engineering and Management, ETH Zurich, M.Sc. in Chemical Engineering, ETH Zurich, Link: Philip G. Moscoso personal webpage</td>
</tr>
<tr>
<td><strong>Dr. Chao Wang</strong></td>
<td>Ph.D. in Computational Mechanics, Rosharon, TX, US, Materials and Structural Engineering, Non-Destructive Testing (NDT), Infrared Thermography, Mechanic of Materials, Finite Element Method, Thermal, Laser, Microwave, Signal Processing</td>
</tr>
<tr>
<td><strong>Dr. Sam-Ang Keo</strong></td>
<td></td>
</tr>
</tbody>
</table>
Contents of the Issue

2. Control Unit for a Two-Wheel Self-Balancing Robot. 7-12
3. Impact of Fabric Density, Color and Composition of Plain Weave Fabric on Ultraviolet Protective Factor. 13-15
4. Potential Impacts of the Advent of Fully Autonomous Driving and Foreseeable Hindrances against Widespread Adoption of Robot Cars. 17-22
5. Effect of Scouring and Bleaching Agents on Whiteness Index and Bursting Strength of Cotton Knitted Fabric. 23-28
Remote Health Monitoring System using Wireless Body Area Network

By MD. Zahidul Islam, Sazzad Hossain Rafi & MD. Murad Miah

University of Dhaka

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

Strictly as per the compliance and regulations of:
Remote Health Monitoring System using Wireless Body Area Network

Md. Zahidul Islam, Sazzad Hossain Rafi & Md. Murad Miah

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.

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 evaluate 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.
III. Parameters Estimation and Calculation

a) Body Temperature

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

$$q = \frac{p \times 5000}{1024}$$

(i)

Celsius value = $\frac{9}{5} q$ 

(2)

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

$$\frac{C}{5} = \frac{F - 32}{9} = \frac{K + 273}{5}$$

(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.

$$F = \frac{9}{5}C + 32$$  \hspace{1cm} (4)

$$K = C + 273$$ \hspace{1cm} (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 abnormal 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:

$$\text{Standard deviation} = \sqrt{\frac{\sum(x - \bar{x})^2}{n}}$$ \hspace{1cm} (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.](image)

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.

![Figure 4: ‘Health Monitoring’ app to receive data from a microcontroller via Bluetooth module.](image)

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).

<table>
<thead>
<tr>
<th>Temperature using Thermometer</th>
<th>Temperature using Device</th>
<th>Percentage of Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>98F</td>
<td>99F</td>
<td>1.02%</td>
</tr>
<tr>
<td>100F</td>
<td>101F</td>
<td>1.00%</td>
</tr>
<tr>
<td>97F</td>
<td>98F</td>
<td>1.03%</td>
</tr>
<tr>
<td>98F</td>
<td>99F</td>
<td>1.02%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Pulse Rate (Manually)</th>
<th>Pulse Rate Using Device</th>
<th>Percentage of Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 bpm</td>
<td>65 bpm</td>
<td>8.33%</td>
</tr>
<tr>
<td>70 bpm</td>
<td>75 bpm</td>
<td>7.14%</td>
</tr>
<tr>
<td>75 bpm</td>
<td>78 bpm</td>
<td>4.00%</td>
</tr>
<tr>
<td>76 bpm</td>
<td>80 bpm</td>
<td>5.26%</td>
</tr>
<tr>
<td>110 bpm</td>
<td>112 bpm</td>
<td>1.82%</td>
</tr>
</tbody>
</table>
Table 3: Comparing the output with expected output (Fall Detection).

<table>
<thead>
<tr>
<th>Number of trial for fall detection</th>
<th>Number of Success</th>
<th>Number of Failure</th>
<th>Percent of Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>41</td>
<td>09</td>
<td>82%</td>
</tr>
</tbody>
</table>

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.

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.

<table>
<thead>
<tr>
<th>Components</th>
<th>Price (BDT)</th>
<th>Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arduino Nano</td>
<td>600.00</td>
<td>7.10</td>
</tr>
<tr>
<td>LM-35 temperature sensor</td>
<td>60.00</td>
<td>0.72</td>
</tr>
<tr>
<td>SEN-00162 pulse sensor</td>
<td>1550.00</td>
<td>13.70</td>
</tr>
<tr>
<td>MPU-6050(3-Axis Accelerometer &amp; Gyroscope Sensor)</td>
<td>180.00</td>
<td>2.15</td>
</tr>
<tr>
<td>HC-05 Bluetooth module</td>
<td>280.00</td>
<td>3.34</td>
</tr>
<tr>
<td>Total Price</td>
<td>2670.00</td>
<td>28.00</td>
</tr>
</tbody>
</table>

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.

REFERENCES RÉFÉRENCES REFERENCIAS


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.

GJRE-J Classification: FOR Code: 091599

Strictly as per the compliance and regulations of:

© 2019. D.P.V.J. Jayakody & K.P.G.C. Sucharitharathna. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.
Control Unit for a Two-Wheel Self-Balancing Robot

D.P.V.J. Jayakody & K.P.G.C. Sucharitharatha

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.

1. 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 noise 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...
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]

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.
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](image)

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](image)

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,
  \[
  \text{Filtered angle} = a \times (\text{current angle} + \text{gyro angle}) + (1-a) \times \text{accelerometer angle} \quad [a = \text{Filter coefficient}]
  \]

- Complementary filter algorithm used for the self-balancing prototype,
  \[
  \text{Filtered angle} = 0.9934 \times (\text{previous Angle} + \text{gyro angle}) + 0.0066 \times \text{(accelerometer angle)} \quad [0.9934 = \text{Filter coefficient}]
  \]

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.
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.

\[
K = P_{Kp}H / (H.P_{Kp}H^T + R)
\]

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.

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],

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

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

\[
e(t) = \text{Current (Filtered) Angle} - \text{Target (Reference) Angle}
\]
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.

![Figure 9: PID Control System Structure](image)

Figure 9: PID Control System Structure

![Figure 10: Step response of the control systems corresponding to optimal constant value sets](image)

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

<table>
<thead>
<tr>
<th>Controller Type</th>
<th>Overshoot</th>
<th>Settling Time</th>
<th>Steady state error</th>
</tr>
</thead>
<tbody>
<tr>
<td>PID</td>
<td>High</td>
<td>Very High</td>
<td>Very Low</td>
</tr>
<tr>
<td>PD</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>P</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 1: Performance Chart of Control System Simulations

Table 2: Effect of Control Term Values in Tuning Process

<table>
<thead>
<tr>
<th>Increased Control Variable</th>
<th>Improved Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>K_p</td>
<td>Stability. Rise time</td>
</tr>
<tr>
<td>K_d</td>
<td>Overshoot. Settling time</td>
</tr>
<tr>
<td>K_i</td>
<td>Steady state error</td>
</tr>
</tbody>
</table>

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.
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.

References Références Referencias

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.

GJRE-J Classification: FOR Code: 291899
Impact of Fabric Density, Color and Composition of Plain Weave Fabric on Ultraviolet Protective Factor

Marzia Islam*, Tarifun Akter*, Jannatul Ferdush* & Kamrunnahar

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.

I. Introduction

Skin disease including skin cancer has become very common nowadays. 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 300 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 on erythema 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 Das et al. showed the effect of thickness and weight on UV protection of cellulosic woven fabric [8, 9, 10]. Moon and Palithorpe 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°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:

$$\text{UPF} = \frac{\sum_{400}^{290} E_i S_i T_i \Delta \lambda}{\sum_{290}^{400} E_i S_i T_i \Delta \lambda}$$

Where, $E_i$ is the erythemal spectral effectiveness. $S_i$ is the solar spectral irradiance (in W·m$^{-2}$·Nm$^{-1}$). $T_i$ is the spectral transmission through the textile. $\Delta \lambda$ is the bandwidth (in nm). And $\lambda$ 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]

<table>
<thead>
<tr>
<th>UPF Rating Protection</th>
<th>Category</th>
<th>% UV Radiation Blocked</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 - 24</td>
<td>Good</td>
<td>93.3 – 95.9</td>
</tr>
<tr>
<td>25 - 39</td>
<td>Very Good</td>
<td>96.0 – 97.4</td>
</tr>
<tr>
<td>40 and over</td>
<td>Excellent</td>
<td>97.5 or more</td>
</tr>
</tbody>
</table>

Author a σ α p Q: Lecturers of Northern University, Bangladesh.

e-mail: barna091@yahoo.com
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>
<thead>
<tr>
<th>Composition</th>
<th>GSM</th>
<th>EPI*PPI</th>
<th>Color</th>
<th>UPF</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% cotton</td>
<td>130</td>
<td>132*72</td>
<td>Black</td>
<td>28</td>
</tr>
<tr>
<td>60% cotton 40% polyester</td>
<td>130</td>
<td>132*72</td>
<td>Black</td>
<td>35</td>
</tr>
<tr>
<td>100% cotton</td>
<td>160</td>
<td>144*80</td>
<td>Black</td>
<td>32</td>
</tr>
<tr>
<td>60% cotton 40% polyester</td>
<td>160</td>
<td>144*80</td>
<td>Black</td>
<td>41</td>
</tr>
</tbody>
</table>

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.


This page is intentionally left blank
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

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.

GJRE-J Classification: FOR Code: 280209
Potential Impacts of the Advent of Fully Autonomous Driving and Foreseeable Hindrances against Widespread Adoption of Robot Cars

Mafolayomi Abiodun Oguntona a, Bem Sombo b & Silas Edwin Nduku c

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 the 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!

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. Google, 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 inadvertently 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.

REFERENCES Références Referencias

5. Autonomous Driving is Here, and It’s Going to Change Everything: https://www.recode.net/
6. Driverless Cars are Further away than You Think: https://www.technologyreview.com/s/520431/
7. Here’s How We’ll Get to a World Filled with Driverless Cars: https://www.makeuseof.com/tag/
8. Let the Robot Drive: The Autonomous Car of the Future is Here: https://www.wired.com/2012/
9. Mapping the Road Ahead for Autonomous Cars: https://www.wired.com/2012/02/autonomous-
10. The Big Problem with Self-Driving Cars is People: https://spectrum.ieee.org/transportation/
Effect of Scouring and Bleaching Agents on Whiteness Index and Bursting Strength of Cotton Knitted Fabric

By MD. Tofazzal Hossain, Alimran Hossain, Palash Kumar Saha & MD. Zahangir Alam

Northern University

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.

GJRE-J Classification: FOR Code: 860499

© 2019. MD. Tofazzal Hossain, Alimran Hossain, Palash Kumar Saha & MD. Zahangir Alam. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License (http://creativecommons.org/licenses/by-nc/3.0/), permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.
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

Retreatment 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

1. Collection of Grey Fabric
2. Scouring and bleaching
3. Whiteness Test (By Using Spectrophotometer)
4. Bursting strength Test (By Using Bursting Strength Tester)
5. 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.
Table 1: Bleaching by Hydrogen Peroxide (H₂O₂)

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Hydrogen Peroxide (H₂O₂)</th>
<th>Sodium Hydroxide (NaOH)</th>
<th>Temperature</th>
<th>Time</th>
<th>M:L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.5 g/l</td>
<td>1 g/l</td>
<td>98°C</td>
<td>30 min</td>
<td>1:10</td>
</tr>
<tr>
<td>2</td>
<td>2.5 g/l</td>
<td>2 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3.5 g/l</td>
<td>3 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4.5 g/l</td>
<td>4 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5.5 g/l</td>
<td>5 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Bleaching by Sodium Hypochlorite NaOCl

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Sodium Hypochlorite NaOCl</th>
<th>Sodium Hydroxide (NaOH)</th>
<th>Temperature</th>
<th>Time</th>
<th>M:L</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1.5 g/l</td>
<td>1 g/l</td>
<td>60°C</td>
<td>50 min</td>
<td>1:10</td>
</tr>
<tr>
<td>7</td>
<td>2.5 g/l</td>
<td>2 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>3.5 g/l</td>
<td>3 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>4.5 g/l</td>
<td>4 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>5.5 g/l</td>
<td>5 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Bleaching by Calcium Hypochlorite Ca(OCl)₂

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Calcium Hypochlorite Ca(OCl)₂</th>
<th>Sodium Hydroxide (NaOH)</th>
<th>Temperature</th>
<th>Time</th>
<th>M:L</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>1.5</td>
<td>1 g/l</td>
<td>60°C</td>
<td>50 min</td>
<td>1:10</td>
</tr>
<tr>
<td>12</td>
<td>2.5</td>
<td>2 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>3.5</td>
<td>3 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>4.5</td>
<td>4 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>5.5</td>
<td>5 g/l</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d) Process curve for Hydrogen Peroxide (H₂O₂)

![Process curve for Hydrogen Peroxide (H₂O₂)](image)

Figure 1: Bleaching process curve for Hydrogen Peroxide (H₂O₂)

e) Process curve for Sodium Hypochlorite (NaOCl)

![Process curve for Sodium Hypochlorite (NaOCl)](image)

Figure 2: Bleaching Process curve for Sodium Hypochlorite (NaOCl)
f) Process curve for Calcium Hypochlorite \( \text{Ca(OCl)}_2 \)

![Figure 3: Bleaching Process curve for calcium Hypochlorite (Ca(OCl)_2)](image)

g) Measurement of whiteness Index

Whiteness index of the scoured and bleached sample was determined by the reflectance value of spectrophotometer (Datacolor650) at 10° 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 \( \text{H}_2\text{O}_2 \) 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 \( \text{H}_2\text{O}_2 \) on whiteness index](image)

b) Effect of hydrogen peroxide \( \text{H}_2\text{O}_2 \) 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.
c) **Effect of Sodium Hypochlorite (NaOCl) on whiteness**

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

\[ \text{Whiteness index} \]

\[ \begin{array}{cccccc}
\text{Sample-6} & \text{Sample-7} & \text{Sample-8} & \text{Sample-9} & \text{Sample-10} \\
0 & 10 & 20 & 30 & 40 \\
\end{array} \]

\[ \text{Sample-6} \]

\[ \text{Sample-7} \]

\[ \text{Sample-8} \]

\[ \text{Sample-9} \]

\[ \text{Sample-10} \]

**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.

\[ \text{Bursting Strength (KPA)} \]

\[ \begin{array}{cccccc}
\text{Sample-1} & \text{Sample-2} & \text{Sample-3} & \text{Sample-4} & \text{Sample-5} \\
503 & 503 & 501 & 500 & 499 \\
\end{array} \]

\[ \text{Sample-6} \]

\[ \text{Sample-7} \]

\[ \text{Sample-8} \]

\[ \text{Sample-9} \]

\[ \text{Sample-10} \]

**Figure 5:** Effect of hydrogen peroxide (H₂O₂) 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.

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.
IV. CONCLUSION

With the increase of the concentration of Hydrogen peroxide (H₂O₂), 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 (H₂O₂), Sodium Hypochlorite (NaOCl) Calcium Hypochlorite Ca(OCl)₂ was over 3.5 g/l, there was no remarkable change in whiteness. However, 4 g/l concentration for Hydrogen peroxide (H₂O₂), 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.

REFERENCES RÉFÉRENCES REFERENCIAS

FELLOWS

FELLOW OF ASSOCIATION OF RESEARCH SOCIETY IN ENGINEERING (FARSE)

Global Journals Incorporate (USA) is accredited by Open Association of Research Society (OARS), U.S.A and in turn, awards “FARSE” title to individuals. The ‘FARSE’ title is accorded to a selected professional after the approval of the Editor-in-Chief/Editorial Board Members/Dean.

The “FARSE” is a dignified title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FARSE or William Walldroff, M.S., FARSE.

FARSE accrediting is an honor. It authenticates your research activities. After recognition as FARSE, you can add 'FARSE' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, and Visiting Card etc.

The following benefits can be availed by you only for next three years from the date of certification:

FARSE designated members are entitled to avail a 40% discount while publishing their research papers (of a single author) with Global Journals Incorporation (USA), if the same is accepted by Editorial Board/Peer Reviewers. If you are a main author or co-author in case of multiple authors, you will be entitled to avail discount of 10%.

Once FARSE title is accorded, the Fellow is authorized to organize a symposium/seminar/conference on behalf of Global Journal Incorporation (USA). The Fellow can also participate in conference/seminar/symposium organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent.

You may join as member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. In addition, it is also desirable that you should organize seminar/symposium/conference at least once.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.
The FARSE can go through standards of OARS. You can also play vital role if you have any suggestions so that proper amendment can take place to improve the same for the benefit of entire research community.

As FARSE, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.

The FARSE will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSE member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A. Once you are designated as FARSE, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website https://associationofresearch.org which will be helpful to upgrade the dignity.

The FARSE members can avail the benefits of free research podcasting in Global Research Radio with their research documents. After publishing the work, (including published elsewhere worldwide with proper authorization) you can upload your research paper with your recorded voice or you can utilize chargeable services of our professional RJs to record your paper in their voice on request.

The FARSE member also entitled to get the benefits of free research podcasting of their research documents through video clips. We can also streamline your conference videos and display your slides/ online slides and online research video clips at reasonable charges, on request.
The FARSE is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSE can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSE member can decide its price and we can help in making the right decision.

The FARSE member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN ENGINEERING (MARSE)

The 'MARSE' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.

The “MARSE” is a dignified ornament which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., MARSE or William Walldroff, M.S., MARSE.

MARSE accrediting is an honor. It authenticates your research activities. After becoming MARSE, you can add 'MARSE' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

_The following benefits can be availed by you only for next three years from the date of certification._

MARSE designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSE, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.
We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSE member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSE, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.
Auxiliary Memberships

Institutional Fellow of Open Association of Research Society (USA)-OARS (USA)

Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as “Institutional Fellow of Open Association of Research Society” (IFOARS).

The “FARSC” is a dignified title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as “Institutional Board of Open Association of Research Society”-(IBOARS).

The Institute will be entitled to following benefits:

- The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA)
- The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.
- The author fees of such paper may be waived off up to 40%.
- The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.
- The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.
- The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of “Open Association of Research Society, U.S.A (OARS)” so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.
- The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.
We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

After nomination of your institution as “Institutional Fellow” and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf. The board can also take up the additional allied activities for betterment after our consultation.

**The following entitlements are applicable to individual Fellows:**

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

Disbursement of 40% Royalty earned through Global Journals: Researcher = 50%, Peer Reviewer = 37.50%, Institution = 12.50% E.g. Out of 40%, the 20% benefit should be passed on to researcher, 15% benefit towards remuneration should be given to a reviewer and remaining 5% is to be retained by the institution.

We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

**Other:**

The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:

- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.
In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10% discount if one is co-author or main author among group of authors.

The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.

The Fellow can become member of Editorial Board Member after completing 3yrs.

The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.

Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)

• This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in-depth understanding of the application of suitable techniques to a particular area of research practice.

Note:

In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.

In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.

In case of “Difference of Opinion [if any]” among the Board members, our decision will be final and binding to everyone.
Preferred Author Guidelines

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

Before and during Submission

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and agree to Global Journals’ ethics and code of conduct, along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author’s email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s’) names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted must not have been submitted or published elsewhere and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors’ institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures
Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors’ research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

Appealing Decisions

Unless specified in the notification, the Editorial Board’s decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.
Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27” x 11””, left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word “Abstract” in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper’s subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.
**Format Structure**

*It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.*

All manuscripts submitted to Global Journals should include:

**Title**

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

**Author details**

The full postal address of any related author(s) must be specified.

**Abstract**

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

**Keywords**

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

**Numerical Methods**

Numerical methods used should be transparent and, where appropriate, supported by references.

**Abbreviations**

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

**Formulas and equations**

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

**Tables, Figures, and Figure Legends**

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.
Preparation of Electronic 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.

© Copyright by Global Journals | Guidelines Handbook
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. Constructions 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 through 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.

© Copyright by Global Journals | Guidelines Handbook
• 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:

o Single section and succinct.
o An outline of the job done is always written in past tense.
o Concentrate on shortening results—limit background information to a verdict or two.
o 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:

o Explain the value (significance) of the study.
o 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.
o Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
o 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.

© Copyright by Global Journals | Guidelines Handbook
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.

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

© Copyright by Global Journals | Guidelines Handbook
<table>
<thead>
<tr>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
</tr>
<tr>
<td>Arduino · 1, 2, 3, 5, 6</td>
</tr>
<tr>
<td><strong>E</strong></td>
</tr>
<tr>
<td>Erythemal · 17</td>
</tr>
<tr>
<td><strong>F</strong></td>
</tr>
<tr>
<td>Foreseeable · 22</td>
</tr>
<tr>
<td><strong>H</strong></td>
</tr>
<tr>
<td>Hindrances · 22</td>
</tr>
<tr>
<td>Hydrophilicity · 30</td>
</tr>
<tr>
<td><strong>L</strong></td>
</tr>
<tr>
<td>Legitimate · 26</td>
</tr>
<tr>
<td><strong>P</strong></td>
</tr>
<tr>
<td>Pailthorpe · 17, 19</td>
</tr>
<tr>
<td><strong>S</strong></td>
</tr>
<tr>
<td>Skeptical · 24</td>
</tr>
</tbody>
</table>