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Simulation of Self Powered Piezoelectric Energy Harvesting Shoe

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A B S T R A C T

As the power requirements for microelectronics continue decreasing, environmental energy sources can begin to replace batteries in certain wearable subsystems. Sustaining the power resource for autonomous wireless and portable electronic devices is an important issue. In this spirit, this paper examines a device that can be built into a shoe, (where excess energy is radially harvested) and used for generating electrical power "parasitically" while walking. Piezoelectric polymers hold promise as energy harvesting materials due to their flexibility and strength which make them ideal candidates for use in more diverse applications.

This paper presents a complete system simulation of piezoelectric energy harvesting shoe. The components are described that allows the electrical and mechanical models of the system. The simulations presented here give a detailed description of the performance of the piezoelectric ceramic. The results obtained with the simulation model implemented allow showing how design choices of the system change the periodicity of the transmission and the ability to recharge the battery.

Keywords — piezoelectric polymers, simulation of piezoelectric, periodicity of transmission.

I. INTRODUCTION

Energy has been essential in building up modern society. It is required everywhere from the household light bulb to a mission to Mars. Some energy can be seen, light for example, but most does not have a visible form. Energy is defined in several ways, such as mechanical, electrical, and chemical. All of these definitions are based on where the energy is stored.

Piezoelectricity from the Greek word "piezo" means pressure electricity. It is the property of certain crystalline substances to generate electrical charges on the application of mechanical stress. Conversely, if the crystal is placed in an electric field, it will experience a mechanical strain. Such materials are useful as transducer elements for transducing electrical energy into mechanical energy and vice versa. When an AC voltage is applied, it will cause it to vibrate and thus generate mechanical waves at the same frequency of the input AC field. Similarly, it would sense the input mechanical vibrations and produce the proportional charge at the matching frequency of the mechanical input.

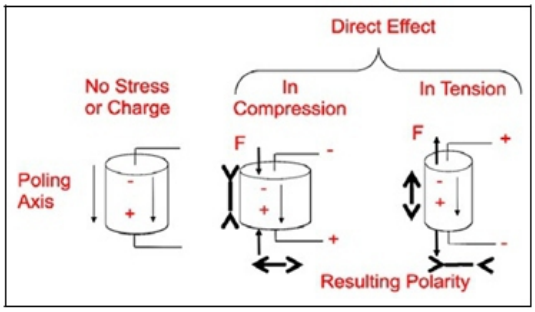

Fig.1.Schematic Direct Piezoelectric Phenomenon

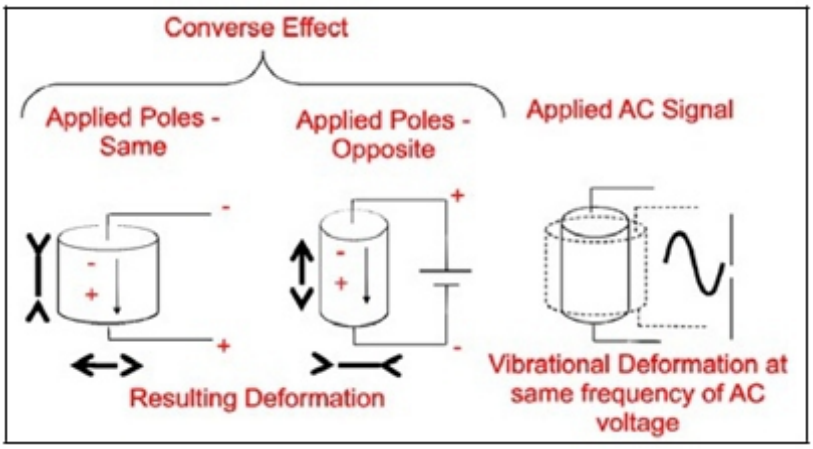

Fig.2.Schematic Inverse Piezoelectric Phenomenon

II. SIMULATION OF PIEZOELECTRIC

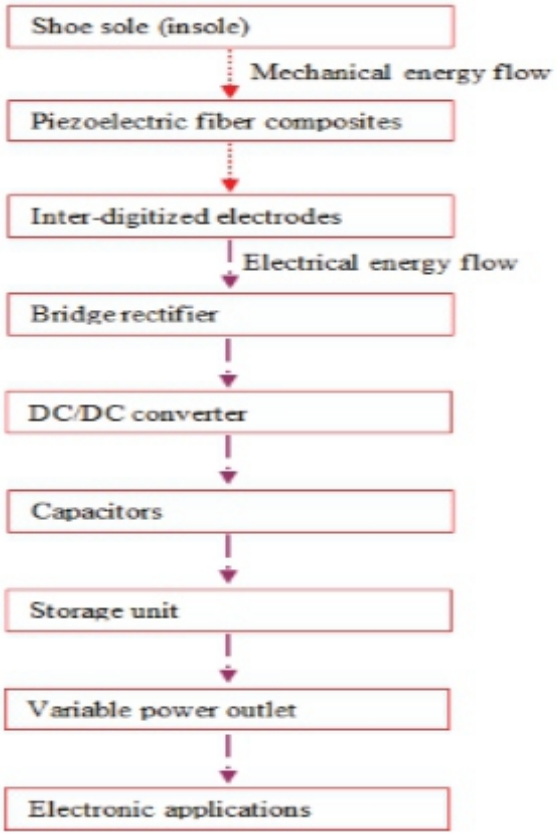

Fig.3.Overall Energy-Harvesting Model.

Basic Circuit for Simulation

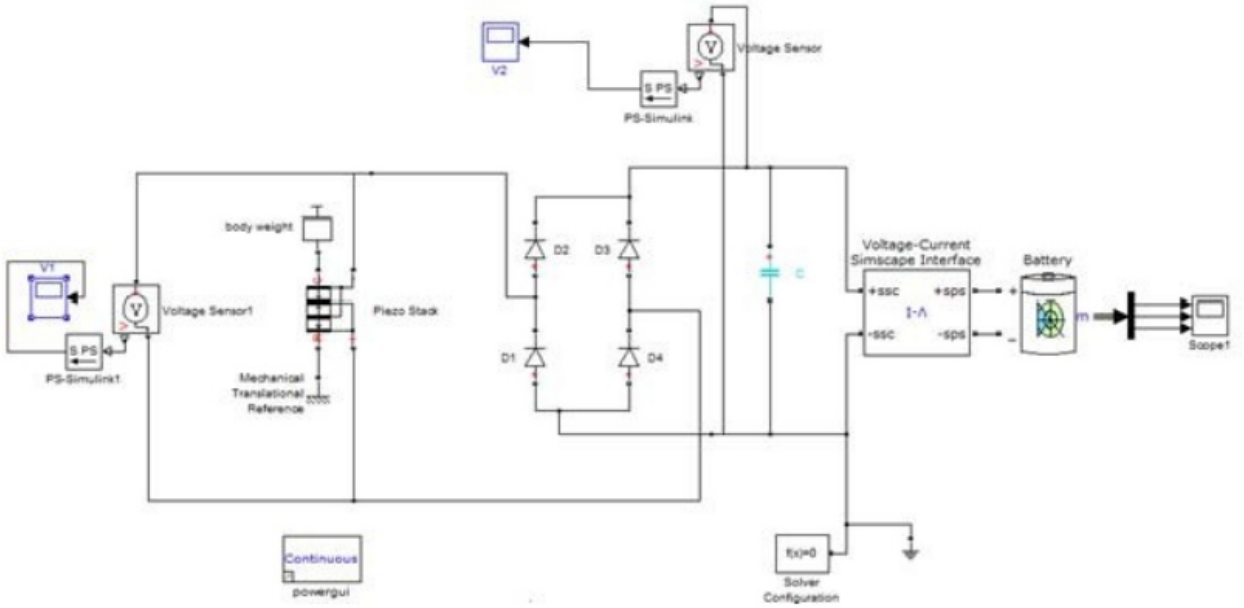

Fig.4.Basic Simulation Model

Description of Circuit Design and Simulation Circuit

The circuit shown in Figure 4 was designed has four phases to represent the overall energy- harvesting circuit modules. The first module (piezo stack) is a mechanical-to- electrical energy conversion module and produces AC power. The second module has rectification (the conversion of AC voltage to DC voltage) unit consist of full bridge rectifier and third unit is an energy-storage unit (intermediate capacitor). The fourth stage is a rechargeable battery that senses the voltage level of the intermediate capacitor and transfers it to the battery charging circuit.

For the purpose of energy harvesting and storage, shoe or sneaker insoles are good sources of mechanical stress, deformation, and vibration when a person is walking or moving his/her feet. With this method, waste-ambient mechanical energy was converted to electrical voltage through a unique energy-harvesting circuit. An overall energy-harvesting model is shown in the circuit below to explain implementation steps and potential applications. In order to have the best efficiency and output power, the circuit was designed and developed according to the ambient-source, characteristics, PZT ceramic-fiber composite and load constraints. The energy- harvesting system is capable of capturing even minute amounts of stress and vibrations, then converting them to electric power sufficient to run low-power electronic systems.

III. RESULTS OF SIMULATION

(a) while a 100 kg man running at a speed of 3 m/s:

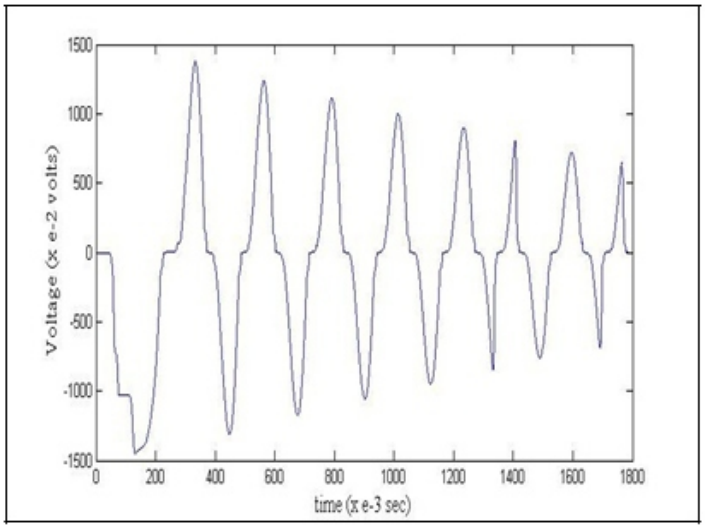

Fig.5.Voltage Produced by Piezo-stack.

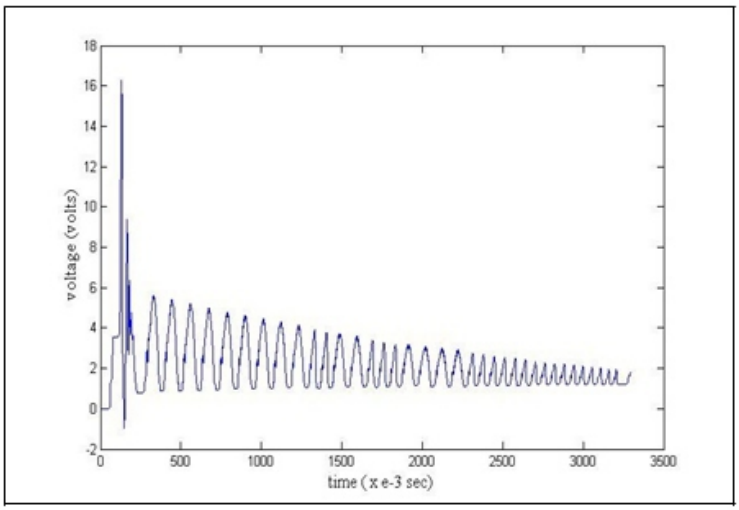

Fig.6.Rectified Voltage Output

Output of 1.2 V Li-ion Battery

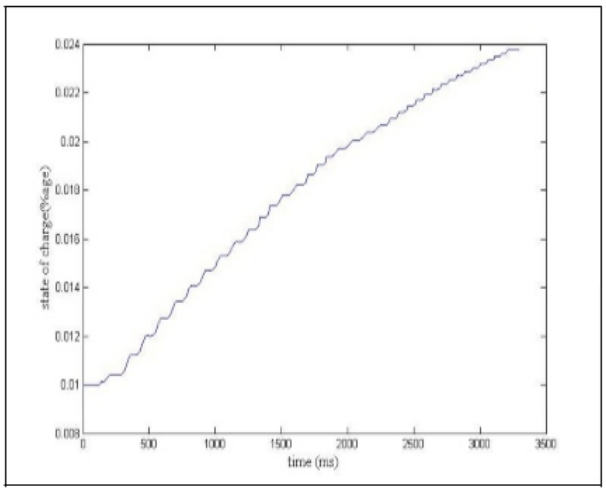

Fig.7.State of Charge

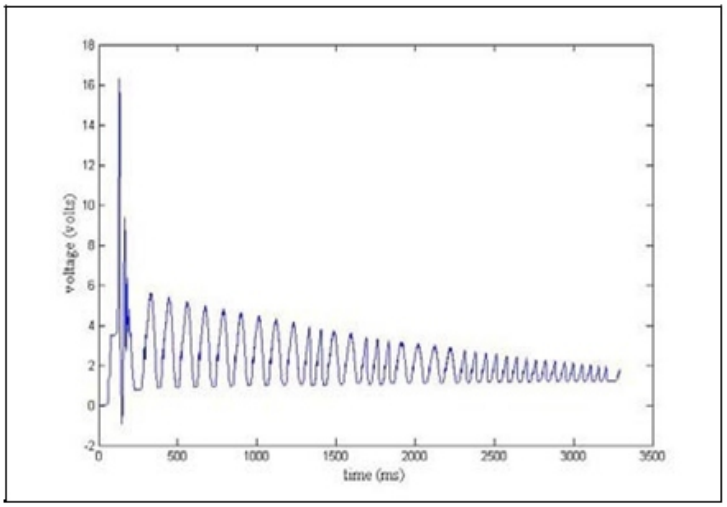

Fig.8.Voltage Output

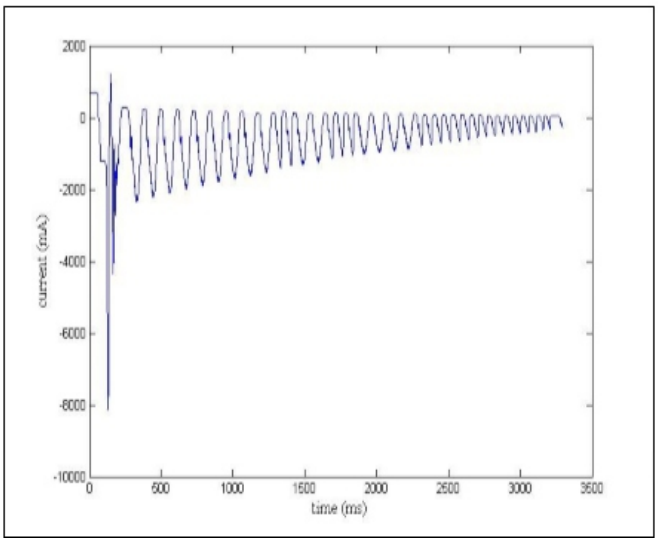

Fig.9.Current Output

(b) while a 100 kg man running at a speed of 6 m/s:

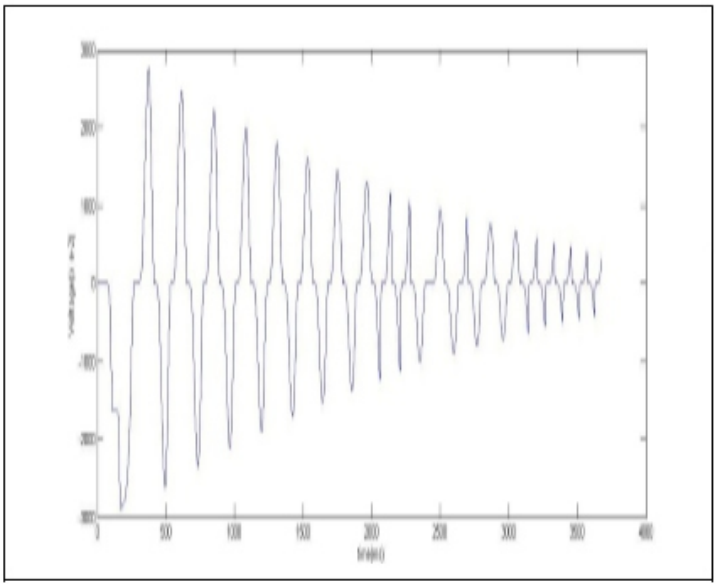

Fig.10.Voltage Produced by Piezo-stack.

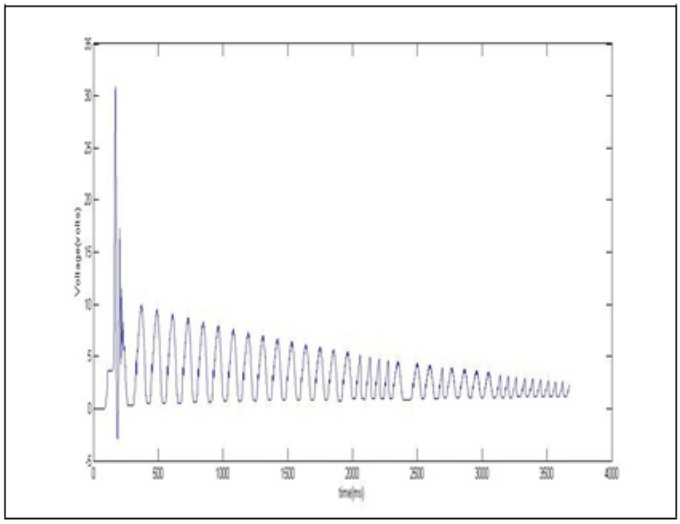

Fig.11. Rectified Voltage Output

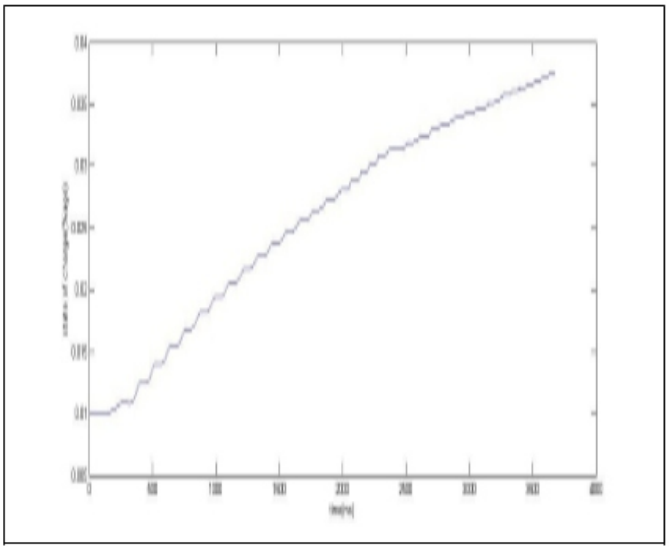

Fig.12.State of Charge

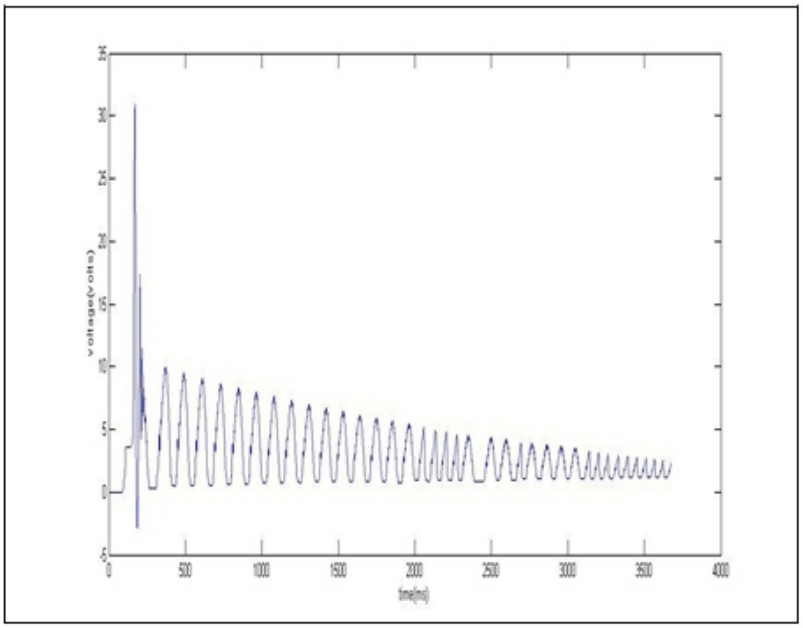

Fig.13.Voltage Output

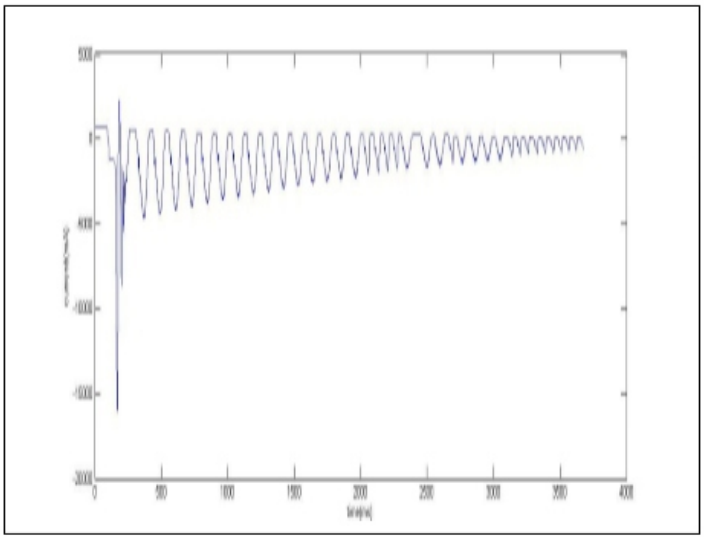

Fig.14.Current Output

© while a 60 kg man running at a speed of 3m/s:

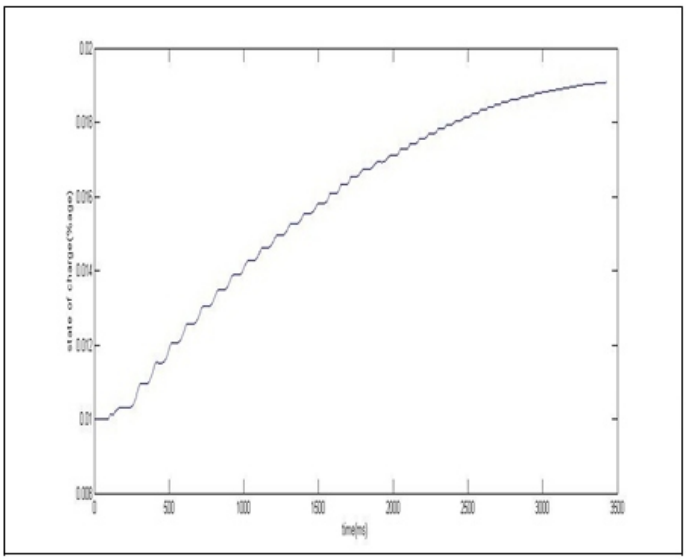

Fig.15.State of Charge

(d) while a 60 kg man running at a speed of 6m/s:

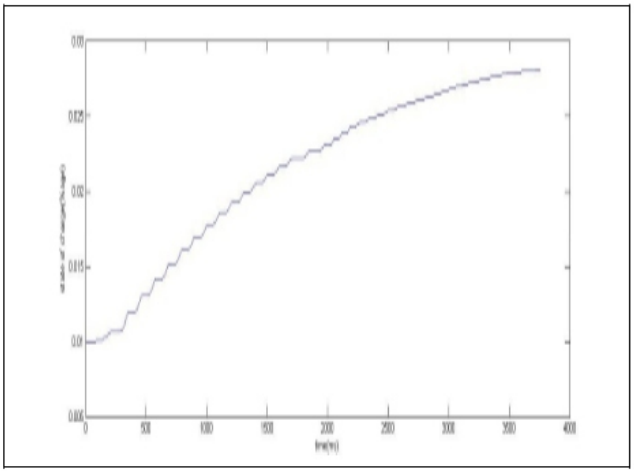

Fig.15.State of Charge

IV. CONCLUSION

On increasing weight and speed, the percentage state of charge increases as shown in Table 1.

Table1. Variation in State of Charge(%age) with speed and weight.

speed/weight	100kg	60kg
3 m/s	0.02372	0.01908
6 m/s	0.03743	0.02803

In order for these devices to be useful, several criterions must be met. First, they must generate enough power. For most of the applications discussed so far, the requisite 1-5 mW of power is already being produced in our simulation. Till now we have studied various parameters of piezoelectric and done simulation using these parameters. Further we have simulated simple charging of the Li-ion battery and obtained various plots.

V. ACKNOWLEDGEMENT

It is our great privilege to express our deep gratitude and indebtedness to our guide Mr. ASHUTOSH SHUKLA, for leading us to the topic, "SIMULATION OF SELF POWERED PIEZOELECTRIC ENERGY HARVESTING SHOE", as well as providing us all the necessary guidance and the inspirational support throughout the project work. We are grateful for the hours he spent in discussing and explaining even the minute details of the work in spite of his hectic work schedule. He listened patiently and authoritatively as he guided and gave his valuable suggestions.

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A Biodiversity Conservation Area Using Holistic and Modular Architecture

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ABSTRACT

Green architecture and engineering aim to minimize the use of available resources by maintaining and protecting the ecosystem and optimizing its benefits to humans and the ecology. The rich biodiversity of Mindoro Island, Philippines has always been on the pipeline project of the province. However, strategies for maximizing the benefits of a small area imposed challenges and hindered many conservation projects. This study utilized modular architecture, biophilia, and biomimesis as design concepts. The design implemented the use of inverted pyramid-shaped modules supported by pilotis to lessen the interaction of the construction project to the proposed site. Five modules are built accordingly and strategically connected by a modular bridge for accessibility. The body of the Mindoro dwarf buffalo is represented by the container van used as the mainframe of the modules; the legs are represented by the pilotis used as structural columns, and the body-built is represented by the inverted pyramid-shaped single-pile structures. The administration building was also inspired by the sturdy built of Mindoro Dwarf Buffalo (Bubalus mindorensis) and designed to cater the administrative functions and activities, while the proposed shops and commercial areas are designed to boost the local economy.

Keywords *Biomimesis, Biophilia, Modular Architecture, Mindoro Dwarf Buffalo, SIMBOLIKHA*

1. Introduction

As technology and the economy continue to prosper, the need to maintain the natural environment has been the subject of much research. The role of sustainability in maintaining the present Earth's condition for future generations is becoming a growing concern for environmentalists, engineers, and architects. Sustainable and eco-friendly architecture and engineering aim to promote better life and to move towards eco-friendly earth [1] as it strives to maximize the resources with environmental impacts [2]. Sustainable development considers the whole and balanced ecosystem, supporting biological diversity and global environments, empowering social participation, and enhancing economic growth [3]. With the massive industrialization and globalization experienced by the Earth, biodiversity has been given limited consideration and conservation remains a pressing environmental challenge [4]. Humans acknowledged that our dependency on biodiversity is the key player for survival and the innate relationship brings compassion to protect the ecosystem [5, 6].

Engineering and architectural concepts are gaining much attention in the various approaches to biodiversity conservation. The concept of modular design focuses on the use of functional subsystems, interfaces, and sub-members that form parts of a bigger group. The modular approach offers flexibility in the design and lessens the project cost by maximizing the innate system's characteristics [7]. The use

of fabricated modules offers a promising and high-tech approach to reducing construction costs [8], reduces the overall construction schedule, offers more improved quality, and reduces resource wastage [9,10]; and can be applied in a housing project varying from single to multiple dwellings [11]. A new concept of modular housing focusing on residential areas explores the capability of cold-formed steel structures based on the functional structure of the house, sound management of the circulation areas, optimization of living spaces and minimalistic design, and conformity to the appropriate design standards [12]. The modular constructions are fabricated in a highly extensive process and the modules are delivered and assembled to the site maintaining the structural integrity [13]. Further, the modular approach offers economic benefits as it provides improved productivity in terms of life cycle cost [14], energy performance, and environmental impacts [15]. Therefore, modular construction can offer strategies to achieve sustainability [16, 17].

Another promising approach in architectural design is biophilic architecture which believes humans have an intrinsic relationship with nature and the human tendency to explore and associate him with the natural world [18], considering sustainability and low environmental impacts and offering a restorative design [19]. Biophilic design can be achieved by incorporating plants, water, and animals in the natural built-in environment; using patterns and materials that depict nature, and describing how humans act accordingly with spatial arrangements [20]. With the increasing environmental awareness, designers shifted their concerns in relating their creations to the mitigation climate change impacts and prevention of natural/environmental degradation [21] considering the thermal performance, air and water quality, proper sound insulation, noise reduction, provision for stormwater and wastewater management, and the protection of the biodiversity [22,23]. Strategies in applying design include the following considerations: the of water fountains, ponds, aquariums, and rainwater facilities and optimizing the natural water features to enhance the water sources and create a sense of closeness to water sources [24,26]; use of operable windows, vents to increase the natural ventilation [24-26]; use of glass walls, skylights atria, and reflective materials to lighting; use of green roofs, green walls, and façade and placing of indoor potted plants to increase the green and encourage positive and light mood [27]; imitating the contour and built of organisms in building forms, structural system and components to create connections with the environment and challenging the designer's creativity [20,28].

This study investigated literature discussing the importance of green engineering and architecture sustainability, natural light and ventilation, and appropriate strategies to achieve eco-friendly design. Biophilia design described as the natural connection of humans with and the way of imitating nature's designs and processes to solve human problems [29] was the main focus of the study. The proposed design tries to incorporate the biophilic design considering the health and well-being of present occupants in the study area [30], and the recommended list of biophilic design qualities emphasized that the human body and mind developed senses based on the surrounding environment [31]. The biophilic design was applied in an interior design of a health center by applying 52 of Kellert's list of biophilic design attributes covering the landscape and architecture application considering the wind direction, thermal comfort, and air quality [32]. Results of the study showed that sound space can be provided to people by adding green and sustainable patterns and elements of the built-in environment [33]. An in-depth analysis of biophilic design as connectors of humans to the built-in environment was investigated and found that biophilic design is not just an addition of green design but takes into consideration the physique, symbols, patterns, and origins [34-35]. Further, the biophilic design was applied in river restoration in a Southern European river and transformed into canal and culvert pipes using regenerative sustainability by implementing green and blue infrastructure and providing a retention basis for water

storage considering the reduction of climate change risks [36].

The Philippines belongs to the 18-mega biodiverse countries of the world and two-thirds of the earth's biodiversity can be found in the country. However, unique biodiversity supported by a large variety of ecosystems, landscapes, and habitats is facing challenges from human activities with 24% land area of the country gradually declining [37]. Mindoro Island is considered as the smallest among the faunal regions in the country 62 species of mammals, 273 birds, 62 reptiles, and 15 amphibians with 149 species can be found in Mt. Halcon, Mt. Calavite, and Mt. Iglit- Baco [38]. At present, Mindoro island houses 354 animal species, 35 of them are endemic, and 24 were named by the World Conservation Union for the threats of extinction. More so, the island's ecological condition continues to decrease in the past decades affecting its biodiversity. In 1900, it was at 70% old-growth forest; 1920 it was 60%; in 1960 it was at 40%; 1987 at 23.7%; 1998 at 22.2 %; 2003 at 8% [39]. The unique biodiversity of Mindoro Island offers challenging opportunities for other unnamed and unrecognized animal species. Mindoro is famous as the home of the Mindoro dwarf buffalo (Bubalus Mindorensis), a small hoofed mammal endemic to the province and the only endemic Philippine bovine, and is now a critically endangered species [40]. The proposed site for the development of a conservation area is the only place in Mindoro where the remaining species of the Mindoro dwarf buffalo is can be seen. To help the Mindoro dwarf buffalo Conservation Program in the province, the researchers offer a development plan exploring the natural built-in environment in Mt. Iglit Baco necessary for the protection and survival of remaining species of plants and animals.

This study aims to provide a design that offers space and area for the exploration of biodiversity using modular architecture and biophilic design. SIMBOLIKHA is a proposed Mindoro Biodiversity Conservation area purposely designed in the foothills of Mt. Iglit-Baco National Park, Calintaan, and specifically aims to establish a facility for environmentalists for their respective endeavors by maximizing the natural characteristics of the built-in environment; design a park for leisure and recreation for educational purposes; offer an area for animal species for exhibition, study, and observation; and design a space that would respond to the rescuing needs in the wildlife such as the rehabilitation of sick, injured and orphaned animals and eventually to release them to wildlife or its natural habitat. While the biophilic design is applied by imitating the natural physique of the Bubalus Mindorensis and optimizing the natural characteristics of the built-in environment using screened walls to allow natural light and ventilation.

2. Materials and Methods

2.1. Site Inspection/Assessment

The researchers conducted a site inspection on the proposed site of the Biodiversity Conservation Area. The environmental analysis included an inventory of the present facilities, animal and plant species, and other essential facilities relevant to the realization of proposed plan. Site Analysis is produced to present the results of the site inspection conducted. The gathering of data, site inspections, and environmental analysis was conducted from February to June 202.

2.2. Project Description

SIMBOLIKHA is a proposed Mindoro Biodiversity Conservation Area as the center for Mindoro

Islands' flora and fauna discovery, exploration, and care. The proposed design offers a place for the observation, attention, and other needs of existing animal and species; and a place for the exploration of species to be discovered yet (Fig. 1).

Fig. 1 shows the regions included in the proposed site. A large area of the proposed site is used for the conservatory, showroom for plants and animals, fauna observatory, public viewing ponds, ranger stations, and laboratory to cater to the space requirement of the remaining species of plants and Mindoro dwarf buffalos. While the areas for souvenir shops, parking areas, and lecture rooms, and quarters were placed in the front of the site to ensure the natural diversity will not be disturbed by any activities incurred during the construction. The horticulture laboratories and animal veterinary rooms will be places for the biologist, veterinarians, and environmentalists to explore, investigate, and respond to the needs of the plants and animals. SIMBOLIKHA aims to generate income for the community and promote tourism through learning, exhibition facilities, flora and fauna exposure, and interactive activities. All parts of the design considered the protection of the existing ecology not to disturb, destroy or alter the naturally built environment.

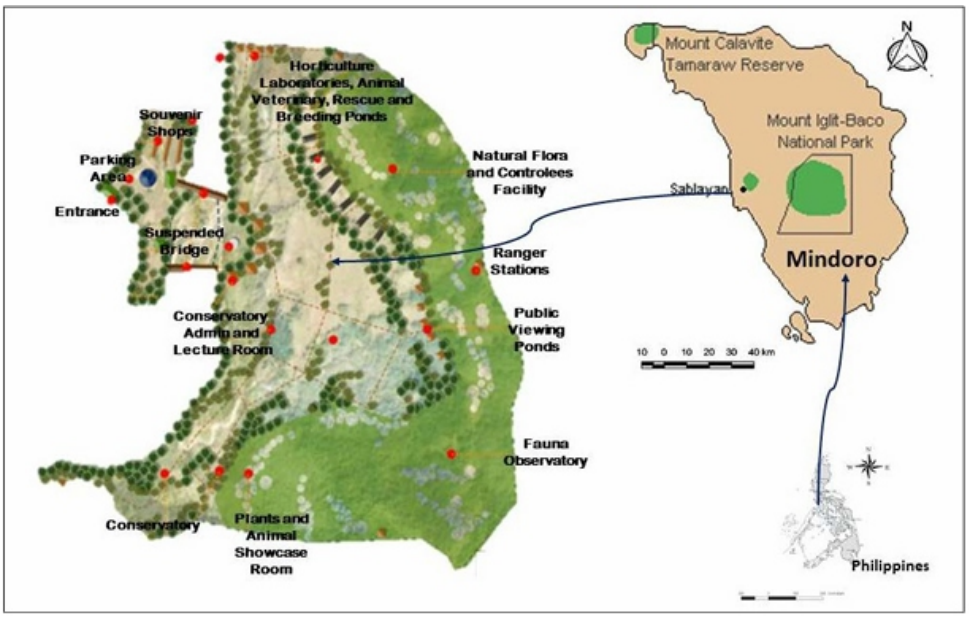

Figure 1. The geographic location of the study area in the proposed site zones of the Mindoro biodiversity conservation area

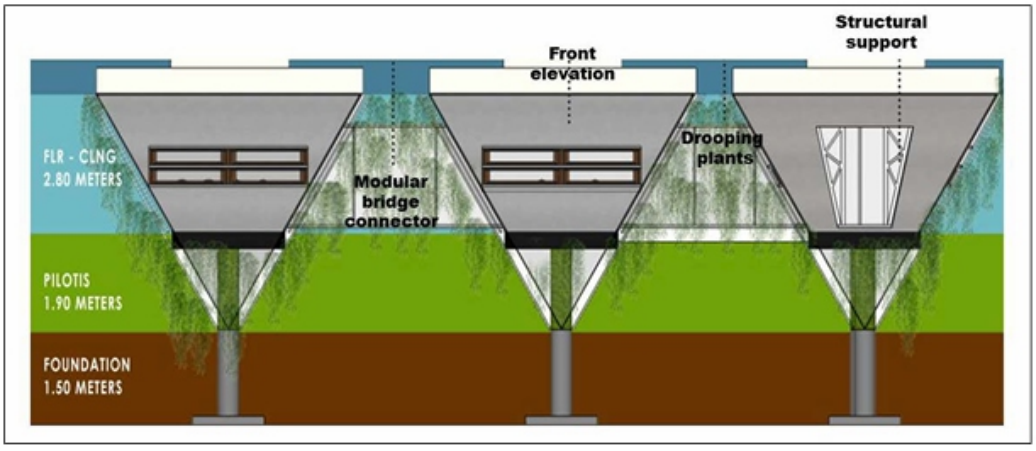

Figure 2. Elevation and connected views of the proposed project

2.3. Design and Structural Concept

SIMBOLIKHA aims to adopt a design that would blend in with the environment and make nature closer to people by promoting ecological conservation. architecture is adopted in the study with consideration of the diverse environment and adaptive to the changing landforms and life needs by placing modular spaces for humans, plants, and animals. The concept of biophilia was applied considering the natural characteristics of Mindoro Dwarf Buffalo (Bubalus Mindorensis). Since the goal of the center is to help and promote growth and development and local biodiversity, the buildings are facilitated on stilts to minimize damage and disturbances during construction. The elevated buildings allow natural lighting and ventilation and encourage existing foliage to thrive and grow beneath the floor buildings. Materials to be used in the development and construction of the proposed design are locally available on the site. The capability of bamboo and other good lumber as a structural of the facilities is optimized during the implementation of the project (Fig. 2).

Fig. 2 shows the elevated foundations of the modules. The inverted pyramid-shaped structures are designed to lessen the interaction of concrete with the natural environment. The pilotis extending to a length of 1.90m are slender columns attached to a 1.50 m x 1.50 m foundation. The pre-cast pilotis will be delivered to the site to lessen the disturbances during construction. The modular connectors are made up of lightweight materials and are semi-open to allow viewing and lighting and ventilation naturally. Drooping plants will be installed to camouflage with the surrounding greeneries and lessen the to animals and as the design strategies to apply biophilia. While the structural supports are made up of lightweight bridge-way modules to hold the structure in the upright position.

3. Results and Discussion

3.1. Site Presentation and Analysis

The proposed Mindoro Biodiversity Conservation Area will seat on the foothill of Mount Iglit-Baco National Park. The park covers almost 75,445 hectares (ha) situated in the center of Mindoro, Philippines bounded by the eight major river systems and characterized by minor slopes, river valleys, and flat terrain. Almost 75% of the park is bounded by the municipalities of Sablayan, Rizal, and San Jose while the remaining 25% covers the municipalities of Oriental Mindoro: Pinamalayan, Bansud, Bongabong, and Mansalay [41]. The park is known as the home of the remaining population of Mindoro dwarf buffalo (Bubalus Mindorensis). The Mount Iglit-Baco National Park is considered as the proposed area since there are species that are already at the park and their welfare is the focus of the proposed biodiversity conservation area, and maximizing the potential of the park will be advantageous both for the species, researchers, biologists, and environmentalists.

The site is located at Sitio Tamisan, Barangay Poypoy, Calintaan, Occidental Mindoro, the Philippines at the foothill of the basecamp and 10km away from the municipal hall of Calintaan. The site is bounded by the municipality of Calintaan in the northeast; Mt. Iglit Baco at the east, Barangay Iriron at the west, and Barangay Tanyag in the south. The site has nearby residential areas in the south-to-west part and is surrounded by greeneries of different types of trees in the hilly area of the west to the north part. Further, the site is an interior lot with a 6.0m wide road facing the entrance of the area. There is only one road to get to the site; a 5km road from the national highway must be passed to reach the barangay hall of Poypoy and to get into Sitio Cabiagan and Sitio Akasyahan; two bridges must be passed to reach the first

landmark and signage of Mt. Iglit and finally to enter the Sitio Calamansian passing again another bridge that led directly into the site. The site can be reached by private or public transportation from San Jose and an hour ride via motorcycle or an approximate 2-hour walk to reach the site (Fig. 3).

Results of the analysis showed that the site has good characteristics for wildlife and biodiversity. In general, the soil is categorized as silt, loam containing not less than 70% silt and clay, and not less than 20 percent sand. There are also existing structures on the proposed site: cottages, small offices, and public toilets that were initially used by tourism and backpackers, and hikers. Since the site is mountainous, rainwater falls directly into the area flowing to the near river and rice fields. Due to the nearness of the site to the river, the area is susceptible to flash floods and surface water runoff. The site has moderate landslide susceptibility from the moderate slope observed in the area. The wind analysis showed that the southwest monsoon and northeast monsoon were maximized by the site orientation. The frontage of the site is facing west while the east faces the Anahaw River. The proposed site receives sufficient sun rays appropriate for animals and plants as reflected in the sun path diagram. Moreover, the result of the strength, weakness, opportunity, and threats (SWOT) analysis showed that the area has a good soil type with clean air quality and is surrounded by greeneries. Since the proposed site is located inside Mt. Iglit Baco National park, the mobilization of construction materials might delay the project's implementation. Poor mobile network signal is also experienced during the investigation which can hinder the communication flows, and the presence of rugged and hilly roads going into the site are some of the weak points of the site. Nevertheless, the proposed project can encourage and attract more tourists and enhance the safety of the natural biodiversity.

3.2. Design Form Evolution

The design form of the proposed project is inspired by the major inhabitant of Mt. Iglit-Baco, the Mindoro dwarf buffalo (Bubalus mindorensis). Biophilia is shown from the orientation of the buildings and facilities integrated into each other based on the degree of their functions to humans; the use of the form concept considering the structure of the Mindoro dwarf buffalo. The body of the Mindoro dwarf buffalo is represented by the container van used as the mainframe of the structure and facilities; the legs are represented by the pilotis used as structural columns, and the body-built is represented by the inverted pyramid-shaped single-pile structures (Fig. 4). The design form shown in Fig. 4 shows the imitated characteristics of the Mindoro dwarf buffalo in the proposed design, the administration building, and other facilities were rectangular –in-shaped, placed, and covered with foliage. The orientation of each container van followed the slope and elevation of the existing natural environment to lessen disturbances and construction damages. The container van will be covered with plants and other greeneries to camouflage the existing environment. The sturdy body built by the Mindoro dwarf buffalo is represented by the structural strength of the container van to withstand the temperature, wind, and other natural factors.

3.3. Architectural Design Translation

After the site analysis and formulation of the design philosophy; design criteria and design concepts were synthesized and translated into architectural designs. The following design criteria were considered in the proposed design of the Mindoro Biodiversity Conservation Area.

3.3.1. Building's Perspective

Mindoro dwarf buffalo is the main inspiration used in the development of the proposed design of buildings and facilities inspired by the strength of the animal's body; the inverted pyramid-shaped single-columned building provides the uniqueness and simplicity of the design. There are five modules reflected in the design representing the five major offices in the proposed project: Receiving room, Research and Lecture room, the Meeting room, the viewing room, and the Laboratory room. Each room is specially designed to meet the expected purpose and activities (Fig. 5).

It can be viewed in Fig. 5, the details and material specifications of the five modules of the proposed Mindoro Biodiversity Conservation Center. All rooms are intended for the use of researchers and environmentalists for their respective activities. The viewing room leisure and recreational educational purposes. All modular rooms have designed areas with light steel gauge walls; hopper windows for better flow of air and light; steel plate flooring supported with I-beam floor framing; and a 1.5 m opening leading to the modular bridge. The inverted pyramid-shaped modules are pre-fabricated, delivered, and assembled on the site. Each module seats on single pilotis with dimensions designed to carry and sustain the module loads. The modules are covered by three layers: wire mesh with a structural frame with naturally growing drooping plants that creates an illusion to animals that everything in the site is in its natural form; polyvinyl chloride (PVC) screen in the structural frame for protection from insects and unwanted penetrators; and the inner layer comprising of steel wall to guarantee the safety of the modules.

3.3.2. Assembly and Connection

The proposed modules are connected by a modular bridge designed to facilitate the flow of transactions on each module. The modules are oriented in a U-shaped to maximize the land area (Fig. 6).

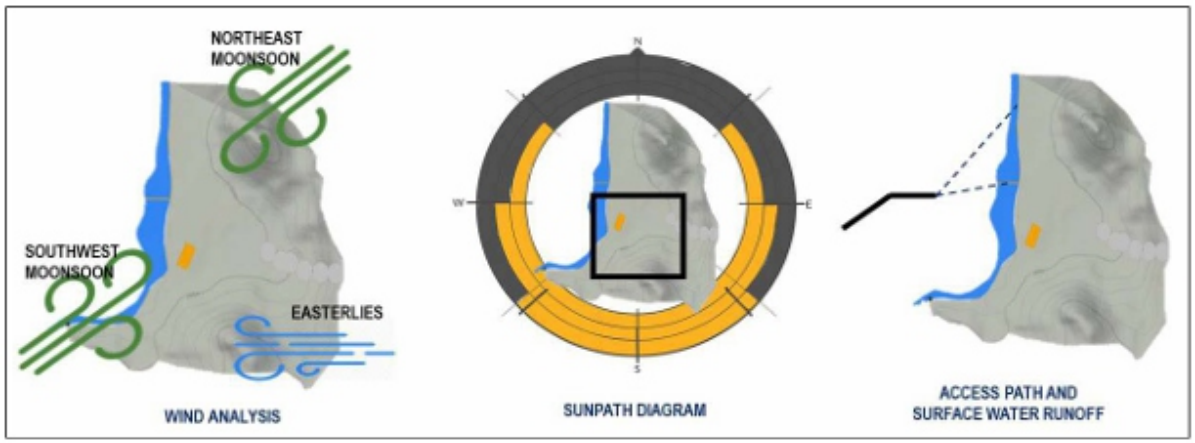

Figure 3. Site analysis of the proposed project

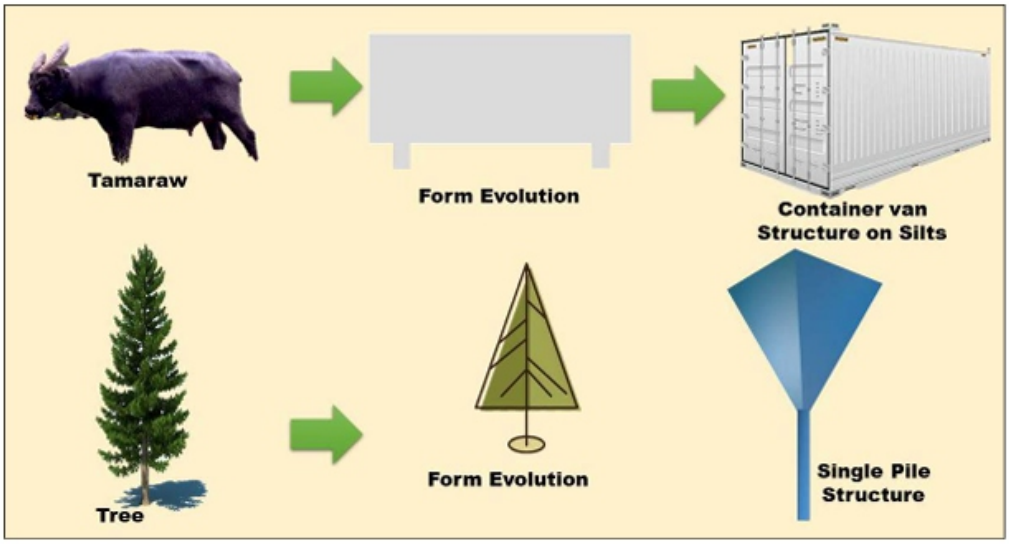

Figure 4. Design form concept adopted in the proposed project

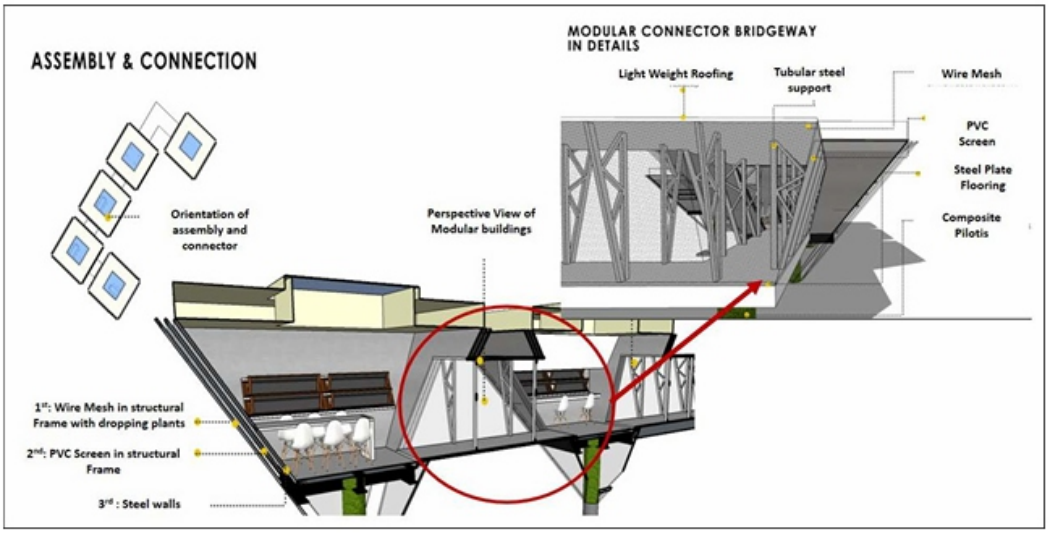

Figure 5. The building perspective and details of each module

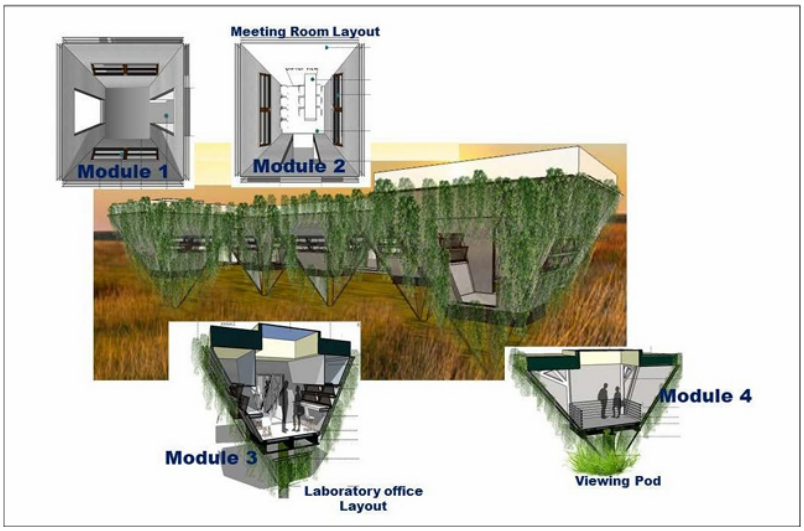

Figure 6. Proposed details of connection and modular bridge

Figure 7. Proposed administration building

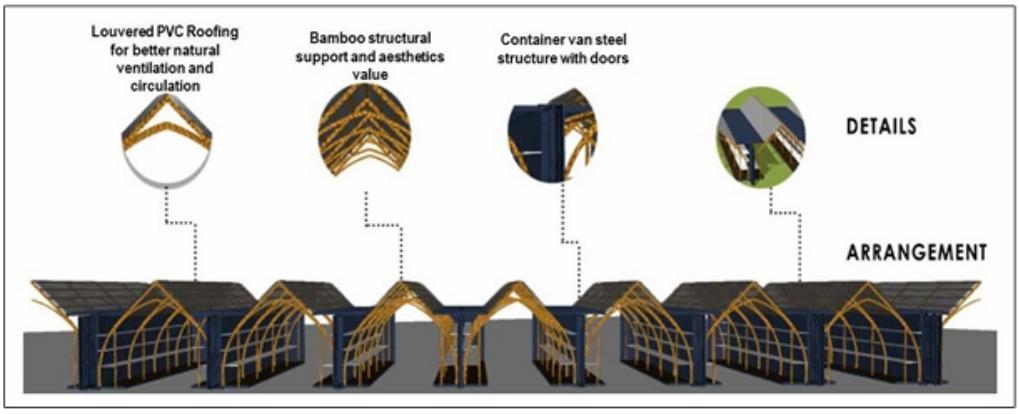

Figure 8. Details of the shops and commercial spaces

Reflected in Figure 6, the modular bridges connecting all the modules are supported by pilotis with I-section steel as reinforcement to the concrete post while the flooring is made up of steel plate supported with I-beam running through the mid and web support. A PVC with wire mesh is installed to allow the flow of natural light and ventilation. The bridge way is framed with tubular steel that provides strength and prevents the bridge way and the modules from swaying and lateral buckling. While the roofing is made up of lightweight material reinforced with steel tubular frames.

3.3.3. Administration Building

The proposed design of the Mindoro Biodiversity Conservation center provided an area for the Administration Building. The office is intended to cater to all the administrative functions and activities of the The building will house the Director, the Tourism office, the Finance and Accounting unit, and the head of the general services (Fig. 7).

The administration building shown in Fig. 7 seat on a container van is strategically installed considering the natural built-in environment. Approximately, six container vans were welded together to create a better space for the Administration building. The interior of the container van is maximized to provide spaces for the office; lobby and receiving area; and comfort room. A reinforced concrete slab floor is

is considered in the porch area supported by steel frames to hold the container vans in place. While the entire Administration building is supported by pilotis extending to the concrete foundation.

3.3.4. Shops and Commercial Spaces

One of the promising spaces in the proposed Mindoro biodiversity Convention Center is the shops and commercial areas, designed to provide additional features for tourists and visitors. The area is designed to market the livelihood of local products, harvest fruits and vegetables and souvenirs, and exhibit booths. The area is placed in the front of the proposed site to attract visitors upon their entrance and exit into the Center (Fig. 8).

4. Conclusions

This paper tries to introduce a design for Mindoro Biodiversity Conservation Center. meet the need of researchers and environmentalists for their respective activities by maximizing the natural characteristics of the built-in environment. The analysis showed that the site has good characteristics for wildlife and biodiversity as the area is still rich in flora and fauna, and natural ecology. Results of the SWOT Analysis described that the area has good soil type and is surrounded by greeneries. Since the proposed site is located inside the Mt. Iglit-Baco protected zone, mobilization of construction materials and poor network signal may compromise the implementation of the project. The design adopted the modular architecture as the design concept by dividing the proposed site zones into modules and built individually but has interrelated functions.

The biophilic design is considered in the proposed design and inspired by the natural characteristics of the Mindoro dwarf buffalo. There are five inverted pyramid-shaped modules presented in the design each with a distinct function and connected by a modular bridge. Each module is designed to serve its functions as receiving area, research and lecture room, meeting room, viewing room, and laboratory room. The inverted pyramid-shaped modules were designed to maximize the site zone so that lower portions of the modules still serve as a natural area for the ecosystem, and minimize construction damages and disturbances. The five modules were structurally supported by single columned pilotis extending to the ground and foundation. The modules are protected by three layers: wire mesh with drooping plants to camouflage the environment, a PVC screen for protection; and a steel wall in the inner layer. The bridge connects all the modules and is assembled strategically to facilitate the movement and activities in the modules. An Administration building is also presented in the design and built-in a 44ft. container van. Six container vans were structurally analyzed to determine conformance to the design loads and cater to the areas for administrative functions. The container vans represent sturdy build of the Mindoro dwarf buffalo that must stand still in all types of natural and man-made disasters. The administration building is also supported by pilotis designed to hold the modules and administration building in place. Lastly, the shop and commercial areas were designed to boost the economy of the proposed site as they offer areas to market local products, exhibits, and souvenirs. The shop and commercial areas maximized the use of bamboo in the design as structural support and web members; the body is the container van cut and placed on the sidings and walls of the booths. The proposed design successfully integrated modular architecture and biophilic design by exploring and optimizing the naturally built-in environment. The design also offers areas for commercial activities to boost the economy and promote tourism.

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Speed Control of Seperately Excited DC Motor using Adaptive PID Controller

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A B S T R A C T

This paper deals with the idea to find perfection for Model Reference adaptive PID Control (MRAPIDC) by providing smooth control to the separately excited DC Motor. The PID controller is integrated with the adaptive observer to simplify the implementations. The output of the system is compared to a desired response from a reference model. The control parameters are updated based on this error. The goal is for the parameters to converge the ideal values to match the response of the reference model.

Keywords----Separately Excited DC Motor (SEDM), Model Reference Adaptive Control (MRAC), Model Reference Adaptive PID Control (MRAPIDC).

I. INTRODUCTION

Direct Current (DC) Motors have been dominating the field of adjustable speed drives for over a century. It is due to their excellent operational properties and control characteristics; hence are used extensibly in variable-speed drives. DC motor can provide a high starting torque and is used to obtain speed control over a wide range.One of the aims of this paper is to present a way of designing an adaptive observer for separately excited DC motor.

II. MODELING OF DC MOTOR

A separately excited Dc motor could be characterized by the following mathematical model[2]:

$$m_d = m + d_L + d_U$$

$$v_a(t) = R_a i_a(t) + L_a \frac{di^a(t)}{dt} + e_b(t)(2) \qquad (1)$$

$$e_b(t) = K_b m(t) i_f(t)(3)$$

$$K_N + I_a(t) = J \frac{dm(t)}{dt} + Bm(t) + T_L(4)$$

$$v_f(t) = R_f i_f(t) + L_f \frac{di_f(t)}{dt} \qquad (5)$$

Where, va(t) is the armature supply voltage (V); ia(t), the armature current (A); eb(t), theback emf (V);vf(t), the field supply voltage (V);if(t), the field current (A);Ra , the armature resistance (Ω); La, the armature inductance (H); Rf, the field resistance (Ω); Lf, the field inductance (H); Td(t), the developed torque (Nm); ω(t), the motor speed (rad./s); TL, the load torque (N-m); J, inertia of the

system (kg-m); Bm,viscous friction coefficient (Nms); Kb, motor constant. The Simulink Model of DC Motor is shown in figure 1.

On taking Laplace transform of the system differential equations (2)–(5) with zero initialconditions, we may write,

$$I_a(s) = \frac{V_a(c) - E_b(c)}{R_a + cL_a} \quad (6)$$

$$E_b(s) = K_b I_f(s) m(s) \quad (7)$$

$$m_N(s) = \frac{K_N + I_a(c) - T_L}{B + cJ} \quad (8)$$

$$I_f = \frac{V_f(c)}{R_f + cL_f} \quad (9)$$

From equations (6) and (8) the transfer function of the DC motor with no load torque and uncertainties (d = 0) is obtained from let TL = 0:

$$\frac{m(s)}{V_a(s)} = \frac{\frac{K_N}{JL_a}}{\left[s^2 + \frac{(JR_a + BL_a)}{JL_a} s + \frac{(BR_a + K_N K_b)}{JL_a}\right]}$$

First considering the case with only load disturbances $T_L \neq 0$

$$d_L = \frac{-T_L\left(\frac{R_a}{JL_a} + c\left(\frac{1}{J}\right)\right)}{\left[c^2 + \frac{(JR_a + BL_a)}{JL_a} c + \frac{(BR_a + K_N K_b)}{JL_a}\right]} \quad (10)$$

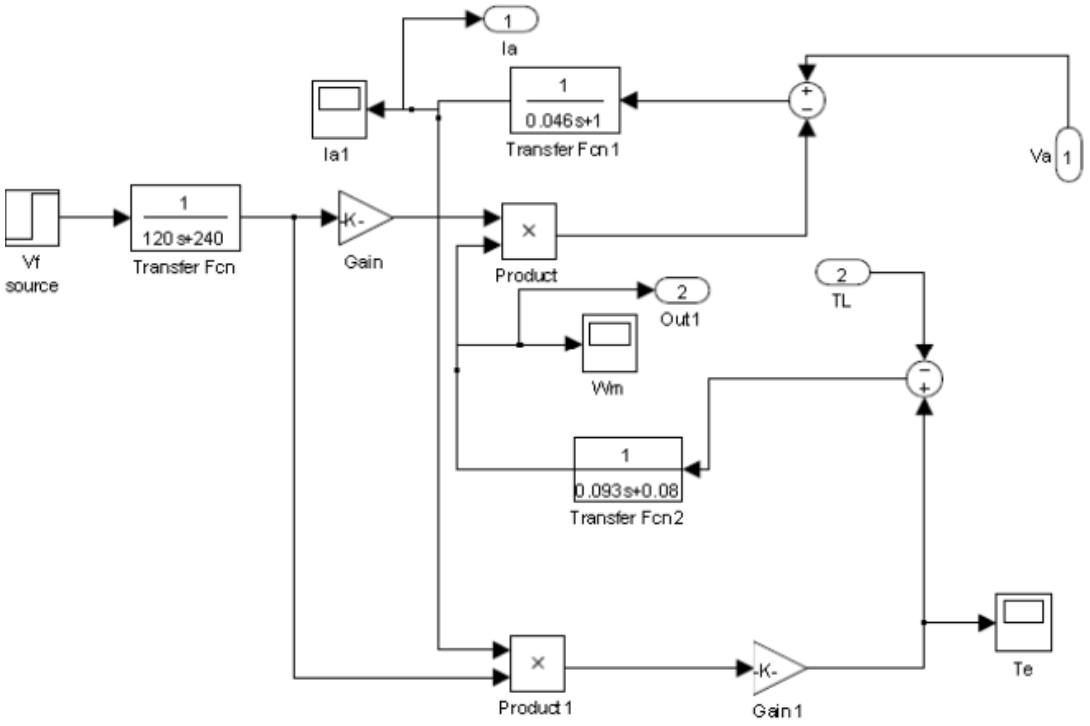

Figure 1: Simulink Model of Separately Excited DC Motor

III. MODEL REFERENCE ADAPTIVE PID CONTROL (MRAPIDC):

The idea behind Model Reference Adaptive Control is to create a closed loop controller with parameters that can be updated to change the response of the system to match a desired model. In Model Reference Control (MRC), a good understanding of the plant and performance requirements it has to meet allow the designer to come up with a model, referred to as the Reference Model, that describes the desired I/O properties of the closed loop plant. When the plant parameters and the disturbances are slowly or slower than the dynamic behaviour of the plant, then a MARC control is used. The model reference adaptive control scheme is shown in figure 2. The adjustment mechanism uses the adjustment parameter known as control parameter Θ to adjust the controller parameters. The tracking error and the adaption law for the controller parameters were determined by MIT Rule [6].

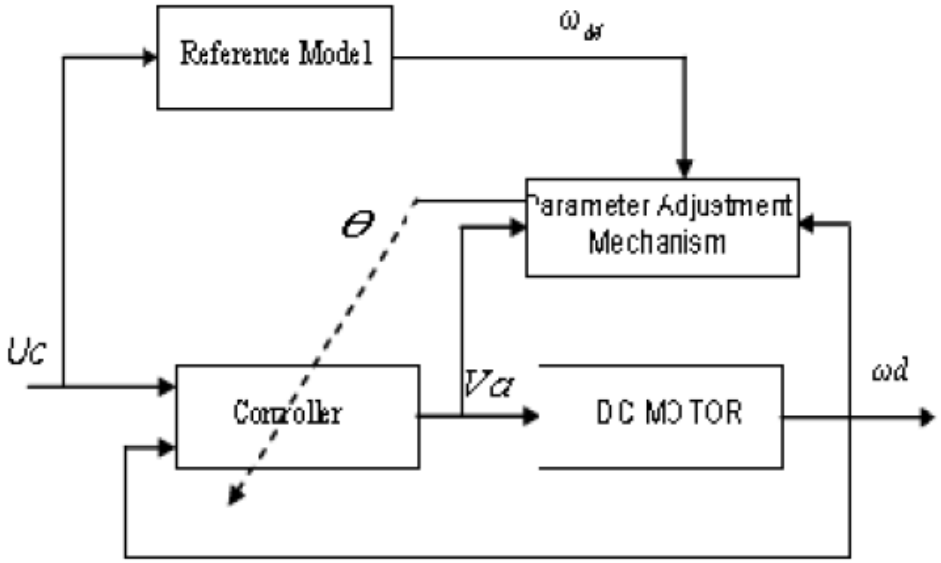

Figure 2: Structure of Model Reference Adaptive Control

MIT (Massachusetts Institute of Technology) Rule is that the time rate of change of Θ is proportional to negative gradient of the cost function (J) that is:

$$\frac{d\theta}{dt} = -\gamma \frac{dJ}{d\theta} = -\gamma s \frac{ds}{d\theta} \qquad (11)$$

The adaption error,s = yp(t) — yM(t). The component of ds⁄dθ are the sensitivity derivatives of the error with respect to adjustable parameters vector Θ. The parameter γ is known as the adaption gain. The MIT rule is a gradient scheme that aims to minimize the squared model error ε2 from cost function [1]:

$$J(\theta) = \frac{1}{2}s^2(t) \qquad (12)$$

The aim is to develop parameter adaption laws for a PID control algorithm using MIT rule. The reference model for the MRAPIDC generates the desired trajectory yM, which the DC motor speed yp has to follow.

Standard second order differential equation was chosen as the reference model:

$$H_M(s) = \frac{b^M}{c^2 + a_{M1}c + a_{M0}} \qquad (13)$$

$$H_M(s) = \frac{b^M}{c^2 + aM1c + aM0} \quad (13)$$

Considering the adaption law of MRAPIDC structure as [5]:

$$u(t) = (K_p e(t) + K_i \int e(t)dt - K_d e^{\times}(t) y_p) \quad (14)$$

Where: $e(t) = u_c - y_p$, K_p is proportional gain, K_i is integral gain, K_d is derivative gain and u_c is a unit step input. Taking Laplace transform of equation (14) we get:

$$U = (K_p E + \frac{K_i}{c} E - sK_d y_p) \quad (15)$$

After applying this control law to the system it is possible to give the following closed loop transfer function:

$$Y_p = G_p((K_p + \frac{K_i}{c})(u_c - y_p) - sK_d y_p) \quad (16)$$

Applying MIT gradient rules for determining the value of PID controller parameters (K'_p, K'_i and K'_d). The tracking error equation (13) satisfies:

$$s = \frac{(G_p K_p c + G_p K_i) U_c}{(c(1 + G_p K_p) + G_p K_i + c^2 G_p K_d)} - Y_M \quad (17)$$

Since exact formulas cannot be used instead some approximations are required. An approximation is made valid when parameters are closed to ideal value as follows [8]: Denominator of plant ≈ Denominator model reference, then gradient method.

$$\frac{dK}{dt} = -y\frac{6J}{6K_i} = -y\left(\frac{6J}{6s}\right)\left(\frac{6s}{6F}\right)\left(\frac{6F}{6K}\right) \quad (18)$$

Where $\frac{6J}{6s} = s$, $\frac{6s}{6F} = 1$

Then the approximate parameter adaption laws are as follows:

$$K_p = \left(-\frac{y_p}{c}\right) s \left(\frac{c}{a_0 c^2 + a_{N1} c + a_{N2}}\right) e \quad (19)$$

$$K'_i = \left(-\frac{y^i}{c}\right) s \left(\frac{1}{a_0 c^2 + a_{N1} c + a_{N2}}\right) e \quad (20)$$

$$K_d = \left(\frac{y^d}{c}\right) s \left(\frac{c^2}{a_0 c^2 + a_{N1} c + a_{N2}}\right) Y_p \quad (21)$$

IV. SIMULATION RESULTS:

In this part, some simulation is carried out for MRAPIDC separately excited DC motor controller. Matlab software is used for the simulation of control systems. Figure 3 shows the Simulink models for both MRAPIDC along with the motor under control. The parameters of separately excited DC motor are considered as:

Km = Kb = 0.55; Ra =1Ω; La =0.046 H; J = 0.093 Kg̊.m; B = 0.08 Nm/s/rad.

Also, the second order transfer function of the Model Reference as follows:

$$H_M = \frac{16}{s^2 + 8s + 16}$$

This reference model has 16% maximum overshoot, settling time of more than 2 seconds and rise time of about 0.45 seconds. In simulation, the constants gammas were grouped in five sets as in table 1.

Table 1: Groups of Gammas

set	1	2	3	4	5
y_p	0.2	0.4	0.6	0.8	1.0
y_i	0.8	1.6	2.4	3.2	4.0
y_d	0.48	0.96	1.44	1.92	2.4

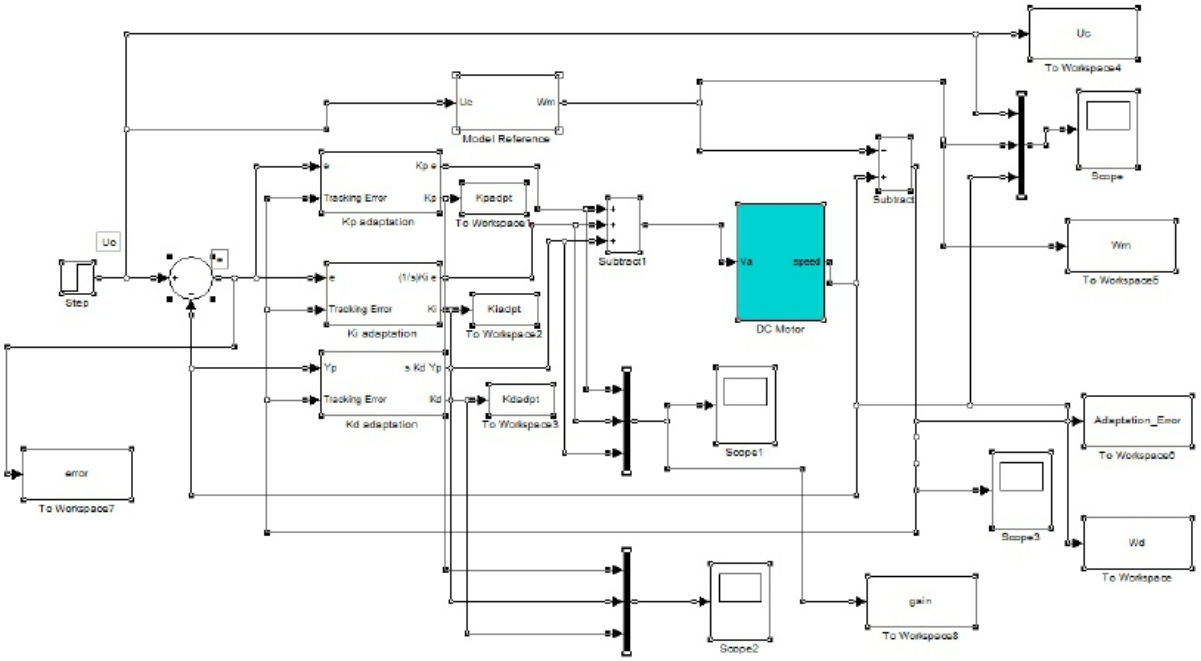

Figure 3: Simulink Model for MRAPIDC

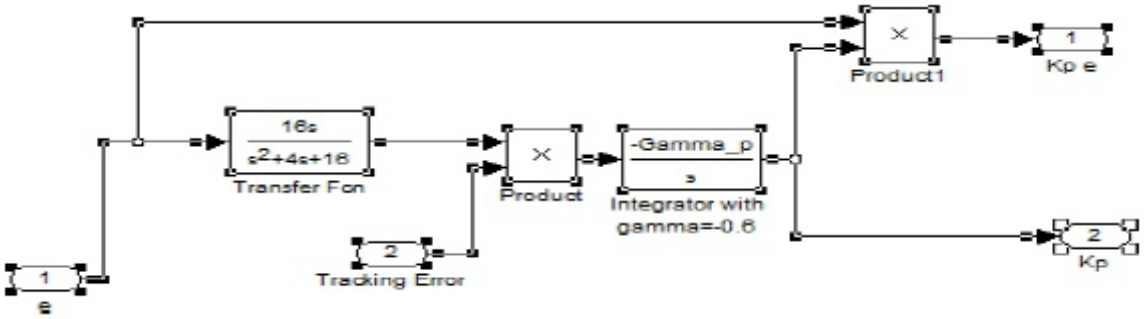

Figure 4: Simulink Model for Proportional Adaption Gain (MIT rule)

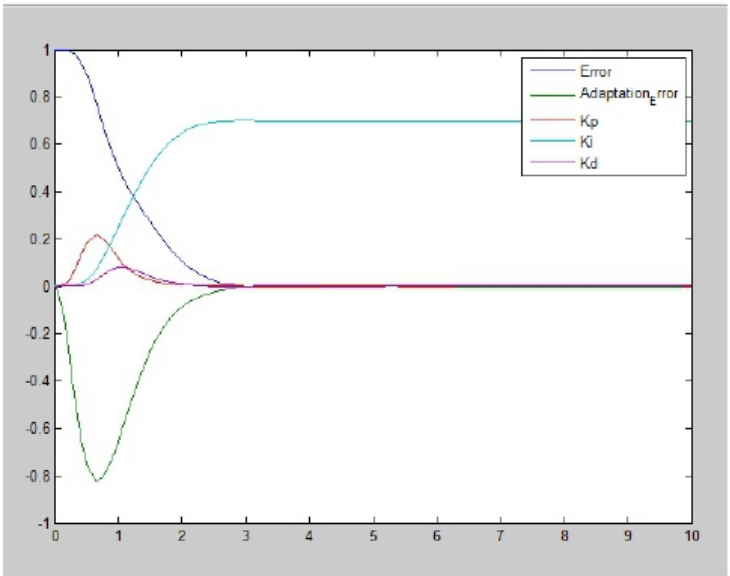

Figure 5: Error, Adaption Error and Adaption PID Gains

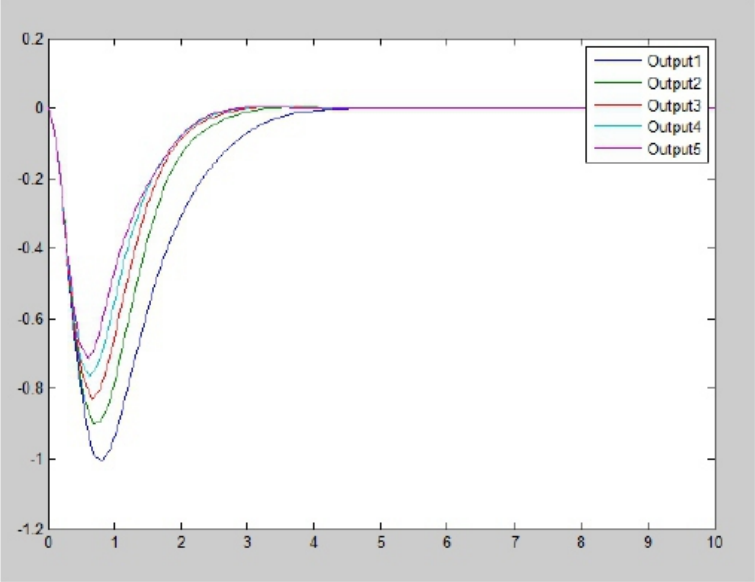

Figure 6: Adaption Error for Different Groups ofγ's

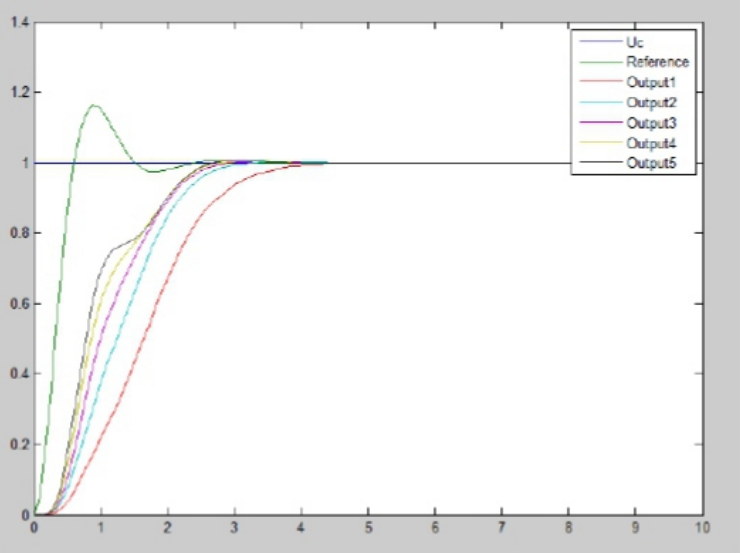

Figure 7: Output Speed for Different Groups of γ's

As shown in figure 7 for low adaption gains, the actual speed has no oscillation but too much delay, so poor performance. Increasing adaption gains the output speed response improved towards matching the desired speed value of model reference. The adaption error is shown in figure 6, while figure 5 shows the error, adaption error and adaption gains for certain groups of gammas. As a result MRAPIDC achieves satisfactory performance. The transient performance specifications are shown in table 2. These simulations show that MRAPIDC requires less information of the process at the same time achieves good performances.

Table 2: Characteristic Values for no Load Speed

Specifications	Set of Gammas				
	1	2	3	4	5
Rise time(sec)	1.15	0.71	0.54	0.46	0.44
Settling time(sec)	3.2	1.34	1.46	1.29	1.42
% max overshoot	0	1	3.8	6.1	8.2

V. CONCLUSION:

It is found that the speed control of the separately excited Dc motor is satisfactory by the use of MRAPIDC. MRAPIDC achieves its desired performance and adaptation gains are responsible to improve the transient performance of the speed response in terms of rise time, overshoot, settling time and steady-state for step speed response.

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Large scale laboratory investigation and simulation of fate and transport of LNAPL plume in variably saturated subsurface

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ABSTRACT

The aim of this study to investigate the fate and transport of a dissolved phase light non aqueous phase liquids (LNAPLs) plume in variably saturated zone using large scale laboratory and simulation experiments. The experiments were conducted in a two dimensional tank setup constructed of one piece of thick stainless steel. The front cover is made of a thick glass sheet and the space between the two walls is packed with a sandy soil of particle size 0.5-1 mm free from organic matter. The solute flux of 100 ml/h was provided as the point source of 50 ppm concentration of dissolved toluene, an LNAPL representative, from one side of the tank. The water flux was taken out from the tank at the other end to maintain the constant water table. The samples of soil water were collected using ports having equal horizontal spacing of 13 cm from two horizontal layers situated 60 cm apart vertically in the steel box. The collected samples were analyzed in triplicates by GC- MS. The laboratory investigation were compared with the simulation experiments using HYDRUS 2D by incorporating biodegradation as a sink term. The spatial movement of LNAPL showed different decreasing trends in lateral and vertical directions at observation points away from the source location. The breakthrough curves showed the fast degradation rate at initial time which started decreasing with progression in time before reaching to the equilibrium. The equilibrium peak concentration of the LNAPL decreases while going towards the outlet showing biodegradation of the considered hydrocarbon in the soil-water system. The results of this study may assist in applying bioremediation in field and for decision making related to planning of industrial locations.

Keywords: *Groundwater contaminant modeling, LNAPL, 2D Laboratory Investigation, Biodegradation, HYDRUS 2D,*

1. Introduction

Soil-water resources are the fundamental supportive natural resources to life on the earth. Whereas the increasing pollution through different sources likes industrial effluent, municipal waste, etc. becomes threats to the soil-water resources. Petrochemical are the most common pollutants to degrade the soil-water systems (Seeger et al. 2011) and found to be toxic and carcinogenic at high concentrations (Nadim et al. 2000, Zhang et al. 2010). The accidental spills and leakage from the industrial units, and underground storage are the main sources of such pollutant to (sub)-surface (Bento et al. 2005).

Petrochemicals are popularly referred as non-aqueous phase liquids (NAPLs) due to their immiscibility with water. On the basis of density, these pollutants are classified in light non-aqueous phase liquids (LNAPLs) and dense non-aqueous phase liquids (DNAPLs) (Yadav et al. 2013). The LNAPLs movement in the subsurface is mainly dominated by advection and hydrodynamic dispersion mechanisms (Yadav et al. 2011). Biodegradation of these pollutants also take place during their movement in subsurface. In subsurface, the environmental variables like temperature, soil moisture content and fluctuation of water table over times affects the fate and transport of these pollutants (Dobson et al. 2007).

Many investigations were conducted in small scale batches but such experiments only useful to observe the biodegradation rates, adsorption coefficient, and Henry's coefficient of the pollutant in the laboratory. In the batch systems the soil-to-solution ratio is low and there is no flow component applied so it cannot accurately represent the real field situation of the aquifer. Mesocosm experimental studies using columns have been attempted to realize the dynamic flow component under controlled laboratory conditions. These experiments provide a link between microcosms and field scale to observe movement of the pollutant in small scale (Sturman et al. 1995, Yadav et al.2012). Whereas most of these experiments focuses on the single parameters characterization. Therefore, the large scale experiments are needed for incorporation of different governing parameters to domain.

Very few researches were investigated the large scale fate and transports using experimental information based simulation under variable environmental condition. Therefore, in this study we investigated the fate and transport of a dissolved phase LNAPL plume in variably saturated zone using large scale laboratory and simulation experiments.

2. Methodology

2.1 The LNAPL Representative

The analytical standards for toluene were purchased from Sigma New Delhi INDIA. The physiochemical properties and the chemical structure of these chemical are shown in Table 1. The 50 ppm dissolved phases were prepared by adding 10 ml of the pure phase LNAPLs in 990 ml of miliQ water and shaked 24 hours using magnetic stirrer.

Table 1. Physiochemical properties and structures of Toluene

Parameters.	Toluene
1. Molecular formula	$C_6H_4(CH_3)_2$
2. Molecular weight	106.2
3. Density, [g cm^{-3} (at 20^0C)]	0.8611
4. Viscosity, [cP (at 20^0C)]	0.648
5. Water solubility [mg L^{-1} (at 25^0C)]	156
6. Diffusivity [cm^2s^{-1}]	$7.2*10^{-6}$
7. Structures	

2.2 Experimental Media

The fine sand having particle size 0.5-01 mm used as experimental media. The physiochemical properties of the experimental media describes in the table 2. The India standard (IS) sand 650 grade-II having less than 1 mm & greater than 0.5mm particle distribution sizes were used. Before use in tank, sand were washed and oven at 100^0 C for 24 hours. The oven dried sands was used in the final setup of the sand tank.

Table 2. Physical and chemical properties of the experimental porous media.

Porous media type	Sand (g hg-1)	Silt (g hg-1)	pH	EC	OM[a]	Bulk Density (g/cm3)	Dimension (l*h*w) cm
Sand	92.8	4.2	5.5	4.9	0%	1.65	150×60×10

2.3 Laboratory setup & Method

The experiments were conducted in two dimensional tank setup constructed of one piece of thick stainless steel formed into a box with inner thick sheet (figure 1b). The front cover is made of a thick sheet and the space between the two walls is packed with a sandy soil of particle size 0.5-1mm free from organic matter. A solute reservoir was installed at the same water table. The solutes were taken by the peristaltic pump (Model RH-P100VS-100-2H) having the both side jointed viton tubing. The viton tubing is recommended for the LNAPLs studies. The water flux of 100 ml/h was provided as the point source of 50 ppm concentration of dissolved toluene, an LNAPL, to the sand from one side of tank. The same water flux was taken out from the tank at the other end to maintain the constant water table and to represent the actual groundwater flow scenario in unconfined aquifers. The samples of soil water were

collected using syringe (0.55×25mm) from ports having equal horizontal spacing of 13 cm from two horizontal layers situated 60 cm apart vertically in the steel box. The samples were directly injected into 1.5 ml vials (Agilent vials) having air tight caps without any air contacts. The air phase samples were also collected from the head space ports situated in top portion of the steel box. The samples were immediately analyzed by the GC-MS (figure 1b). In this experiment, the entire 2D tank setup were air tight and there were no any single open space except the outlet at other side of the tank. Therefore, the volatilized concentrations were the actual in head space and there were no loss of concentration from the tank in any phase of LNAPLs.

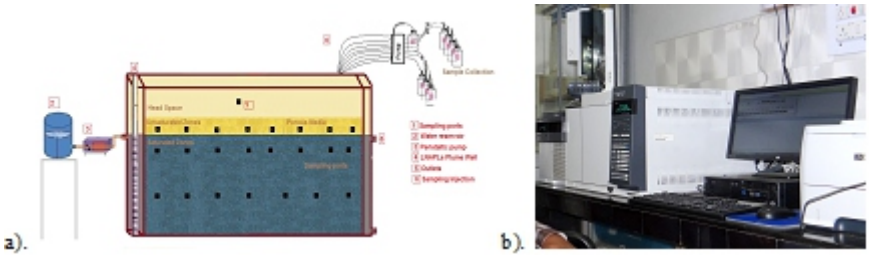

Figure 1. Laboratory setup, a). Schematic diagram of the 2D sand tank setup, b). GC-MSD analysis of collected samples.

2.4 Sample Analysis

For the analysis of the hydrocarbons especially LNAPLs, the Gas Chromatography recommended using the FID or MS detector. In this study, the collected water samples were analyzed by Gas Chromatography Mass Spectrometer (GC-MS) model Agilent-7890B showed in figure 1b. The calibrations were taken first using the different know concentration and the toluene specific command were set in the GC. The samples were placed in automatic sampler having 16 vials ports. The 5 minutes were taken as analysis time and the analyzed peak were filtered. The peak area were gives the concentration of the samples. The triple analysis of each samples were considered and the mean values are using for the further simulation.

2.5 Simulation Experiment

The groundwater flow was simulated using the mixed form of Richards's equation as:

$$\frac{\partial \theta}{\partial t} - \nabla . D(\theta) \nabla \theta - \frac{\partial K}{\partial z} = 0 \qquad (1)$$

Where $\frac{\partial\theta}{\partial h}$ is the specific moisture capacity function, K(h) is the unsaturated hydraulic conductivity, $D(\theta) = K(\theta)/C(\theta)$, is the unsaturated diffusivity, z denotes the vertical dimension. Furthermore, for the multi-dimensional advection-dispersion mechanisms of solute transports in subsurface with a decays kinetics was simulated using the classical advection dispersion equation as

$$D_x \frac{\partial^2 c}{\partial x^2} + D_y \frac{\partial^2 c}{\partial y^2} + D_z \frac{\partial^2 c}{\partial z^2} - V_x \frac{\partial c}{\partial x} - \frac{r}{n} = \frac{\partial c}{\partial t} \quad (2)$$

Where $D_{x,y,z}$ = hydrodynamics dispersivity in x,y,z, direction, V_x is the uniform velocity and r is the biodegradation kinetic decay rate.

The simulation experiments were evaluated using the laboratory based information to the most cited subsurface model HYDRUS 2/3D. The HYDRUS 2/3D is graphical user interface tool coded on above mention governing equation of the variably saturated subsurface water flow and solute transport (Yu and Zheng 2010). The simulation projects were created in 2D general types of geometry having vertical plane XZ. The tank size domain was graphical edited as X: 10 cm, Y: 150 cm, Z: 90cm and simulated for water and standard solute transport. The van-Genuchten-Mualem single porosity model was selected for the domain. The van-Genuchten parameters were used as material properties of the water flow for single sand media showed in the table 3.

Table 3. The ven-Genuchten parameters for sand media.

Sr.No	Media	Qr [-]	Qs [-]	á [1/cm]	n [-]	Ks[cm/hr]	L[-]
1	Sand	0.045	0.43	0.145	2.68	29.7	0.5

Similarly, Space discretization followed the Galerkin finite elements approaches and time discretization followed Crank-Nicholson scheme for the solute transport. Upper boundary water flow conditions were atmospheric boundary and the lower boundary water flow were No flux boundary. Similarly, the solute transport upper boundary conditions were concentration flux BC and the lower were zero concentration gradient (figure 2). The observation points were graphically edited in two horizontal layers having same dimensional domain as in 2D tank. Finally the mass balances were calculated for the study domain.

3. Results and Discussion

The relative concentration of toluene was plotted as a function of time at different depths, known as breakthrough curves (BTCs), for 2D study domain. The observed BTCs for the study domain are shown in Figure 2 a, b using the dot points of different colors for different observation points. In figure 2a, the breakthrough curve shown for the 1st horizontal layers having nine ports with 13 cm distance to others. The BTCs also represented the time of arrival of LNAPL plume at different location of the tank with their relative concentration profile. It was observed from the breakthrough curves that the equilibrium

concentration time for observation ports was higher for ports nearby sources as compared to the others which clearly indicated the amount of biodegradation happening in the soil mass. The difference in ports BTCs with respect to sources BTCs gives the degradation rate and showed the fast degradation rate at initial time and start decreasing with progression in time before reaching to the equilibrium. The equilibrium peak concentration of the LNAPL decreases while going towards the outlet showing spatial biodegradation in the define study domain. The shape of the BTCs for all ports was same at equilibrium peak concentration.

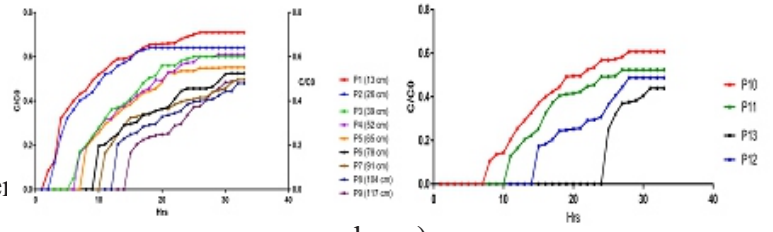

Figure2. Experimer yer) b) P10-P13 (2nd layer)

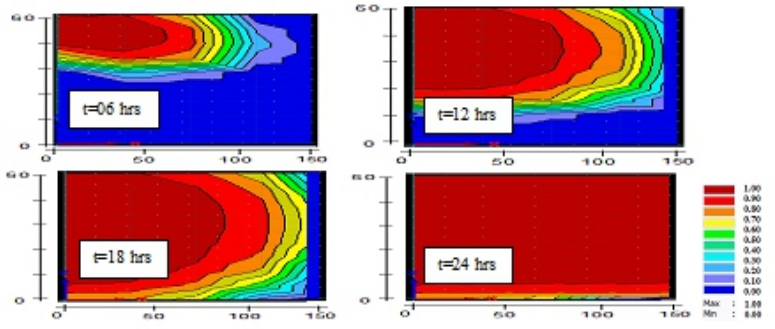

Figure 3. Simula hrs, t=18hrs, t=24 hrs.

The laboratory investigated BTCs were compared with the simulation experiments using HYDRUS 2D by incorporating biodegradation as a sink term. The simulated spatial plume distribution in domain represented in figure 3 at time 06 hrs,12 hrs,18 hrs,24 hrs. The concentration profile curve of the domain showed the increasing concentration as time advance. After 24 hrs the entire domain showed at equilibrium concentration. Similarly in simulated BTCs also, spatial movement of LNAPL showed different concentration decreasing trends in lateral and vertical directions at observation points away from the source location. The simulated BTCs showed similar time of arrival of the plume at different observation points and similar concentration profile throughout the domain (figure3a,b).

3. Conclusions

The intent of this study was to investigate the fate and transport of dissolved LNAPL plume in variably saturated zone. The experiments were conducted using two dimensional sand tank and simulation in

HYDRUS 2/3D. The simulation underpinning the laboratory experiment incorporated the biodegradation rate as sink also. Therefore, the entire experiment focuses on the spatial movement of the plume in the domain which represented the actual scenarios as in field. It was observed from the breakthrough curves that the equilibrium concentration time for observation ports was higher for ports nearby sources as compared to the others. Both, laboratory and simulated results showed the different concentration decreasing trends in lateral and vertical directions at observation points away from the source location. The breakthrough curves showed the fast degradation rate at initial time and start decreasing with progression in time finally reaching to the equilibrium. The equilibrium peak concentration of the LNAPL decreases while going towards the outlet showing biodegradation of the considered hydrocarbon in the soil-water system. This study on fate and transports of LNAPL may assist in ecofriendly and cost-effective remediation technologies for in situ treatments of polluted soil water resources.

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Role of Jipmer and Rajiv Gandhi Hospital for Women and Children Toward Protecting People's Health in Puducherry: An Empirical Study

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ABSTRACT

Issues and problems of people in overall Indian territory is known as a primary and prime concern of the central government, state government and union territory, because people health was understood by all the people and administration as a core base of all types development and progress ,without which no nation, country ,state and family could be developed and progressed .All these elements are developing and progressing its administrative entity and governance efficiency along with the help and support of people's good health and energy .From family to nation people's healthy health is contributing huge and vastly in its development ,success and ameliorations ,good health status of people of a country is reflecting in its political development, agricultural progress, industry development, efficient administration and education advancement ,its people good health status determines about success and victory of all its international cooperation and policy making because human power or capital is most needful power and essential elements in a countries' international and domestic achievements and success ,from these patterns every state government is making different and unique health related polices and laws with an interest to augment and amplify its political, economic ,agricultural ,educational ,administrative, corporate and industry developments .Good health is being as a epicentre of both human being life as well as in government developments thereby family to country getting so many success and attaining all types of needful progress in its political and administrative developments. Giving an importance to people health preservation and protection has been paid colossal and close attention by all state and central government from post Independence onwards with an interest to fortify and strengthen India's human resource, economic developments and promote India's international cooperation by showing its mammoth human resources power and energy. A nation or family could be identified by its people's good health status thereby it will get supports, famous, recognition and praise from the neighbourhood and international people. Unless nation or a family have above quoted good health system it will be understood and estimated as a poor nation and family which will get much stuff to lift its national economy as equal to international economy as a family is suffering to promote its income status due to having meagre health status .As to strengthen family income ,revenue and protect old aged people's health and facilities it must have healthy successor and descendant, without having such healthy members or person in a family it will suffer just like boneless item, in this regard a nation also will suffer lot and immensely in terms of increasing and developing its economic ,military and agricultural developments because for develop both family and nation they must have strong and steady health status ,for which government have to pay prime and first hand attention on strengthening health status of the citizens .Strong and steady health status are not only being applied by family and nation on generating income and developing economic status of a country but it also used and applied toward protecting of nation sovereignty and territory from the attacks and usurpation of the host country's military forces.

Key words: Nation development, Family growth, Economic development, Agricultural amelioration and Strengthening Sovereignty.

INTRODUCTION

Since Puducherry was annexed into central government Union list on August 16, 1962 it has been making several developmental oriented polices and activities in its all areas of administration. Though it has been facing several hurdles in its administrative and policy making ways but has been paying thinkable and marvellous attentions on strengthening of its health sectors and polices with an aim to save and preserve its people health status from adult people to aged people in a trustworthy and quality ways .Even still now 2020 puducherry has been as one of the hub of the Tamilnadu people in accessing quick and speedy health facilities as well as treatment at a nominal cost, next to Chennai puducherry has been attracted by so many Tamilnadu people in getting free and chief medical facilities though they have had lot government hospitals because here is provided quality treatment, free medical facilities and fair treatment is practiced by the all doctors and government officers. Affecting by many health oriented disease and problems people from Tamilnadu have been coming to various hospital of puducherry .When they were interviewed by the researcher in JIBMER and Rajiv Gandhi Hospital for women and children and other so many hospitals they expressed their feelings on their medical treatment getting from puducherry hospitals are making them easy to access all doctors and hospitals at humanitarian ways without corruption and bribe.

From old age people to young people are able to access free, fair and genuine medical festivals in puducherry without any bias and partiality on the basis of Tamilnadu people and puducherry people. Its mammoth role in facilitating and promoting healthy health status are praised and lauded by all the people when they are cured and recovered from the infected diseases. Its medical policy is not only guarding and saving Puducherry people alone but also protecting and saving Tamilnadu people also from the many risky diseases ,though Tamilnadu government have been established many multibed hospital people did not show faith and concern on those hospitals due to careless ,negligent treatment and unhumanitarian conversation with patients .The main and major reason of those people who are coming to puducherry hospitals from several parts of Tamilnadu for get treatment in various medical disciplines are these hospitals are having dedicated ,responsible and respectable doctors ,workers and nurses thereby they are able to feel convenient to come to this state and recover from the infected and affected disease without any sadness. In these both hospitals very often women are coming to get good treatment at free of cost at fair mode of treatment with the help of doctors ,Rajiv Gandhi hospitals are established for women and children's health development and cure problems in which most of pregnant women are admitted both form puducherry region as well as Tamilnadu state on humanitarian grounds and as mark of federal state of India whereas JIPMER was established with an aim to take care on all state people both Tamilnadu and Puducherry for give generalised medicines .People from Puducherry and Tamilnadu have been showing colossal attention on these both hospitals for an important purpose such as

Patient's responses about JIPMER's hospital health service

SN	Age	Health Problems	Hospital Charges	Patient's Responses
1	24	For Delivery Purpose	Free of Cost	Good Governance
2	55	Diabetes	Free of Cost	Good Hospital administration
3	59	Diabetes	Free of Cost	Good treatment
4	60	Multiple Sclerosis	Free of Cost	Good hospitality

5	60	Diabetes	Free of Cost	Biasfree Treatment
6	65	Crohn'scolitis	Free of Cost	Humanitarian Concern
7	64	Lupus	Free of Cost	Dedicative Nurses
8	67	Rheumato arthritis	Free of Cost	Dedicative Doctors
9	65	Skin Allergies	Free of Cost	Responsible Higher medical Officers
10	68	Asthma	Free of Cost	Enough medical infrastructures
11	69	Celiac disease	Free of Cost	Excellent Medications
12	70	Liver Disease	Free of Cost	Strict and lenient Visitor time
13	71	Cancer	Free of Cost	Pro-Poor service
14	72	Heart Disease	Free of Cost	Pro-Poor service
15	75	Bladder problems	Free of Cost	Pro-Poor service
16	74	Dementia	Free of Cost	Consisting of dutiful hospital workers
17	60	Arthritis	Free of Cost	Frequent medical officers visiting
18	62	Glaucoma	Free of Cost	Good amusement grounds
19	65	Lung disease	Free of Cost	Nice Visitor's staying and sleeping places
20	80	Cataracts	Free of Cost	Modernised Toilets and bath rooms facilities

Source: JIPMER, year 2020

Despite JIPMER was as a centralised hospital it has been doing and discharging its medical ,hospital and medication services to be all the people who are coming across the India ,especially it is doing its sincere duty to both Tamilnadu and Puducherry people's health development and protection without any maladies and prejudice .Though it had been looking multi people's health problems but it has been paying very close attention on looking old aged people's health problems ,in this regard the researcher met fifty people who are aged from 55 to 80 had been possessing aforementioned health problems and came to that hospital for attain reliable treatment and medications .Their responses to researcher questions about hospital's role in saving and protecting their health they said to them that above mentioned positive and praising reason about hospitals nurses ,doctors and higher officers who are taking care on all the patients and monitoring regularly without any time wasting. According to old age d[people perceptions this hospital is saving their money ,time, giving adequate treatment at free of cost

and following strict time table to meet again them in a state time with proper medications thereby they like to come to this hospitals from several parts of the Tamilnadu and puducherry.

Patient's responses about Rajiv Gandhi hospital for women and children health services

1	Age	Health problems	Hospital fees	Patient's Responses
2	20	Admitted for delivery	Free of cost	Proper announcement of women delivery time
3	22	Admitted for delivery	Free of cost	Emergency section with quick medication facilities
4	23	Prenatal health Check up	Free of cost	Identical medical facilities and medications
5	25	Postnatal health Check up	Free of cost	Good Research aptitude of the doctors through curing patients
6	23	Stomach pain	Free of cost	Skilful and efficient research oriented and trained head doctors
7	24	Breast cancer	Free of cost	Properly monitoring patent's health problems at assigned times
8	25	Ovarian and cervical cancer	Free of cost	Doctor caring sincerely over down syndrome children and calling to know their needs and status
9	26	Gynaecological health problems	Free of cost	Offering modernised medications and scanning facilities to the patients.
10	28	Pregnancy issues	Free of cost	Rendered good advice
11	27	Auto Immune diseases	Free of cost	Cared properly
12	24	Depression and Stress issues during delivery time	Free of cost	Derived suitable counselling
13	25	Menopause	Free of cost	Received good medications
14	21	Reproductive hazards	Free of cost	Received scientific tips
15	22	Sexual Problems	Free of cost	Got physiological and psychological tips
16	20	Uterine Disease	Free of cost	Good treatment
17	28	Children health Problems	Free of cost	Rapidly curing medications
18	27	Health problems after delivery	Free of cost	Cured Innovatively

19	29	Periodical Health checkups	Free of cost	Done well and good
20	26	Reproductive Counselling and tips to eat during pregnancy time	Free of cost	Marvellous food tips given by the doctors

Source: Rajiv Gandhi hospital for women and children Year 2020

This hospital has been established for save women from pregnancy issues and save children from mother stomach without pain and problem .To this purpose it has been admitting many pregnant women at free of cost with an aim to facilitate women rights and children rights .Many of them have been coming to this hospitals for access free child delivery, pregnancy health care and all types women and children oriented health medications and remedial measures. according this several women's perceptions this hospital is saving people money ,curing patents at free of cost, many poor people are able to save their life with children at pregnancy time .People money is saved lot and cared carefully by hospital administration without any corruption and commission ,on these aspects hospital is recognised and praised lot by the rural and urban people in which both Tamilnadu and Puducherry people have been accessing this maternity facilities at mutual and humanitarian concern. Particularly this hospital was established for women and children's welfare and safety thereby women are getting excellent benefits form these hospitals without any bias at any reason. As mark of hospital's good treatment and medication the researcher met fifty women in that hospital and directly took interview about that hospital medication for that they expressed in positive and appreciating ways about hospitals services from the nurses to doctors toward caring and treating the patients in a humanitarian and intelligent ways .Though this hospitals has been purchased many costly medication machines which are used at free of costs for treat the patients ,its service is protecting the patients , saving the children and saving the poor people's money thereby they felt it has been doing philanthropic hospital services for multilingual people secular outlook without any bias

CONCLUSION

All patent's responses of hospital's treatment, caring, giving medication, time following and minimising their cost and offering hospitals service to them at cost free patterns are surely and scientifically identified and highlighted about both hospital's secular and welfare administrative method according to Indian constitution's ideologies and principles .In both hospitals women and male are getting proper and satisfied medication and medical services and help on humanitarian ways without any bias ,corruption and commissions ,most of women are getting admitted in Rajiv Gandhi Hospital for delivery ,prenatal and post natal and children caring purposes ,it is specialised and focused hospitals for women and children health development which is rendered by that hospital before pregnancy and after pregnancy and even after childe delivery proper child nurturing guidance and medical assistances are provided at regular period .In JIPMER hospital case study has been done with an aim to old aged people's health problems and cost incurring and saving by this hospital. In this regard this hospital has been providing an adequate medical and medication facilities toward curing and caring old aged people's health problems and saving and minimising their economy thereby zero percent health expenditures are incurring in both hospitals except their personal and food expenditures, rest of fees and costs are supported and shouldered by both hospitals wholeheartedly without any bias and corruptions. Health economy is putting or spending for health problems are taken and happened at this both hospitals are zero, is remarking of welfare polices of Indian construction's principles at cosmopolitan ways.

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