Eco-Design Application to Drive Sustainable Manufacturing

Ziyad Tariq Abdullah*, Guo Shunsheng, and Sheng Buyun

Wuhan University of Technology, School of Mechanical and Electronic Engineering, Wuhan City 430070, Hubei Province, China; Institute of Technology–Baghdad, Mechanical School, Al-Za'franiya 10074, Baghdad, Iraq; Wuhan University of Technology, Mechatronic School, Wuhan City 430070, Hubei Province, China

Eco-design is an eco-innovation as an early integration of environmental aspects in development processes to be sustainable decision making. Reduction of electrical power consumption is one of sustainable manufacturing aims to reduce fossil carbon emission. Such aims can be gotten by application of eco-design for both product design and technological path. Power meters (Kwh) are installed to monitor electrical power consumption of welding machine consumption for oil filter shells manufacturing in a developing country. Power curves of welding process are drawn to find the area under the curve to be further studied to be an insight that enables application of sustainable technological path and eco-design. To see the ability of the current design to include environmental protection aspects as engineering requirements to decrease power consumption and consequently fossil carbon emissions. Current design is studied for robust extraction of interchangeability features, such features can be employed to certain multiple lifecycle of the product at the end-of-life where another lifecycle can be certain by purposing the end-of-life product to be used for the same function or different one. Both of disassembly and eco-design are tried to be applied together to help using of end-of-life shells to service as alternatives products which can be helpful, especially for developing countries of non-industrial infrastructures. Sustainable manufacturing and both of power consumption and fossil fuel and CO_2 emission decreasing are of strong relationship that is proven based on literature of sustainable manufacturing review.

Keywords:

1. INTRODUCTION

Sustainable development to meet the needs of the present with keeping the ability of future needs can be realized through sustainable production of closed supply chain through reverse logistic and closed product lifecycle by remanufacturing which required integrating both environmental assessment and improvement advice techniques. Such integrated eco-design within theoretical design principles for establishing sustainability that leads for eco-strategies of remanufacturing, and reuse of end-of-life products to driver new joining solutions based high disassembly technology. Environmental design is termed as eco-design which is useful for practical application based crowdsourcing of innovations to promote environmental performance as a consequence for establishing of sustainability as a functional requirement. Such eco-strategies for recycling, recovery reuse and remanufacturing of end-of-life products are required supporting of poor disassembly efficiency through rapid assembly and disassembly joining solutions that can be fulfilled by adhesive bonding and disbonding.[1–3] Eco-design introduction to development phase of a product is urgent to cope with environmental impact of manufacturing, distribution, use and the end of life. Results show that consumed electricity and the raw materials in the manufacturing are promoted criteria to assess environmental impacts.[4] Sustainability can be considered as design theme of both product lifecycle assessing and suggestions to innovate a technical system of practical activities providing to ensure sustainable results can be easily embodied into design practice.[5] From point of view of remanufacturing, rapid assembly-disassembly joining solutions are identified as key technology drivers with lead innovations in adhesive disbonding technologies. Environmental protection and sustainability to reduce resource consumptions and environmental friendly manufacturing and an optimized long customer usage phase to leap out multi-material construction concept.

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*Author to whom correspondence should be addressed.

Two-Step Deposition Method of Nanostructured ZnO Thin Films with Various Precursor Concentrations: The High Crystal Quality Enhances the Final Properties

A. N. Afaah[1,2,*], A. Aadila[1,2], N. A. M. Asib[1,2], K. A. Eswar[1,2], M. R. Mahmud[1,2], Salman A. H. Alrokayan[4], Haseeb A. Khan[4], R. Mohamed[3], M. Rusop[2,3], and Z. Khusaimi[1,2,*]

[1]*NANO-SciTech Centre (NST), Institute of Science, University Teknologi MARA (UiTM), 40450 Shah Alam, Selangor, Malaysia*
[2]*Faculty of Applied Sciences, Universiti Teknologi Mara (UiTM), 40450 Shah Alam, Selangor, Malaysia*
[3]*NANO-ElecTronic Centre (NET), Faculty of Electrical Engineering, Universiti Teknologi MARA (UiTM), 40450 Shah Alam, Selangor, Malaysia*
[4]*Department of Biochemistry, College of Science, King Saud University (KSU), P.O. 2454, Riyadh 11451, Kingdom of Saudi Arabia*

ZnO nanoseed were grown on glass substrate by mist-atomization, which then used as ZnO template for the second step of deposition method. Next, ZnO films have been deposited onto ZnO template prepared earlier with various precursor concentrations by solution-immersion method. The thin films were immersed in different concentrations of starting materials; which are zinc nitrate hexahydrate and HMTA. The precursor concentrations were varied from 0.05, 0.10, 0.20 and 0.40 M. The ZnO seeded template which undergoes mist-atomization only, denoted as MA only is prepared for comparison studies to the other thin films. The properties of the thin films were examined by photoluminescence (PL) spectrophotometer, Raman spectrophotometer, and ultraviolet-visible (UV-Vis) spectrophotometer. From the PL measurement, it shows that 0.40 M sample have highest UV emission and from Raman measurements, it was found that the sample immersed in 0.40 M precursor have high crystal quality. From UV-Vis measurements, sharp UV emission at ~378 nm is observed and 0.40 M ZnO thin film shows a better absorption properties. The optical bandgap energy (E_g) of the films was evaluated. The optical bandgap energy of thin film with precursor concentration of 0.40 M have smallest value (3.227 eV). The energy bandgap energy of the resulting ZnO films was found to be strongly influenced by the precursor concentrations.

Keywords:

1. INTRODUCTION

Zinc oxide (ZnO) is a semiconducting material with a wide and direct band gap of 3.37 eV at room temperature that is suitable for short wavelength optoelectronic applications. The high exciton binding energy of 60 meV in ZnO crystals could lead to lasing action even above room temperature.[1,2] ZnO consists of two interconnecting sublattices of Zn^{2+} and O^{2-}. Every of the Zn ions are surrounded by tetrahedral O ions, and vice versa. ZnO is a versatile functional material which own diverse group of growth morphologies, such as nanotubes,[3] nanorods,[4–6] nanowires,[7,8] nanobelts,[9–11] nanocombs,[12] nanopencils,[13] nanopyramid.[14] This semiconducting material received considerable interest due to its wide range of application such as gas sensor,[15] solar cells,[16] UV photoconductive sensor,[17] and biomaterial.[18]

Diverse synthetic approaches have been introduced for ZnO nanostructures such as RF magnetron sputtering,[19,20] electron beam evaporation,[21,22] and pulse laser deposition.[23,24] Among these, mist-atomization and solution-immersion method are appropriate for the synthesis of ZnO nanostructures due to low cost, suitable for large production fabrication and environmentally friendly. Furthermore, ZnO nanostructures are easily formed even on cheap substrates such as glass and therefore they have a promising potential in large-scale production for industrial use.

To the best of our knowledge, our study is the first to grow ZnO nanostructures by the following two-step deposition techniques; (i) mist-atomization and (ii) solution-immersion method.

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*Authors to whom correspondence should be addressed.

AgiRPG: An Agile-Based Role-Playing Game Design System

Wei-Chung Chang[1,2], Teng-Wen Chang[1,2,*], and Chung-Wen Hung[1,2]

[1]*Department of Electrical Engineering, National Yunlin University of Science and Technology, Yunlin 640, Taiwan*
[2]*Department of Digital Media Design, National Yunlin University of Science and Technology, Yunlin 640, Taiwan*

This paper proposes a game-design supporting system that allows map-based role-playing game (RPG) designer can easily design the game, and give the RPG a visual design environment instead of traditional programming interface. Additionally, the agile software development concept has adapted into RPG's development Process, and let game developmental data can be easier managed and reduce redundant information appeared. The design of data and objects are introduced by a modular production and can be portable to different platform. Using an object-oriented approach to perform various elements of RPG in the modular design, providing designers to compose the basic components together and simultaneously increasing the game's expansibility and a more convenient environment for updating.

Keywords: Role-Playing Game, Game Maker, Game, Agile Framework.

1. INTRODUCTION

With the popularity of smart phone-based game (game app), game design has attracted massive independent developers and designers. With current availability of game production tools (or we prefer game design supporting tools), game design has been given power to create diverse games. However, most of design supporting software currently in the market still requires advanced programing skills in prototyping stages. Consequently, the design prototypes are hard to modify after the prototyping stage, including the user interfaces, character attributes calculation, items and equipment's bonus. The only feasible element might be the story plot. This outcome might create a uniform appearance or interaction process. But, it strongly limits the ability of designers in both the interaction and presentation. Also, the similarity from the infeasible tools bored the gamers. Designers need a more viable supporting tool.

Additionally the current online app game platforms also encourage a more diverse design direction for our system. The reason is online channels allow independent game designers receive user feedbacks and distribution directly that is impossible before.

This is to say, instead of marketing analysis or following certain trends, independent designers require more design ability and more focus on game design itself. Only developing a game that most of players want, the game can then sustains itself in the market. Therefore, the design process for independent game

developers should be different than before. Of course, there is still some limitation for such tool. There is still some technical knowledge need to know before developing app game. Such as memory management, object-oriented techniques as well as an extensive programming set of instructions might be the required knowledge for our targeted designers of this research.

Considering the types of game, role-playing games are chosen due to its popularity and the characteristics of cross game types. From recent surveys, computer games have or adapt more elements of Role-playing game (RPG) within, such as rank in shooting games, veteran system in strategy game, skill tree in action games, personal level in business simulation, and so on. These games can almost combine with RPG and thus RPG will become an independent forming or will support other elements in computer games. Given the above, RPG game is chosen.

Several RPG characteristics including text-based[1] (Fig. 1 left) are considered and analysed. For our research, 2D map-based RPG games[2] (Fig. 1 right) are chosen for developing our system. The reason of why we chose this type of RPG games is that the map-style RPG gives players the more visual playfulness and feedback to allow a more complex design system than text-based RPG. However, there is no suitable development platform and sophisticated module to proceed with game developments and other similar types of games. A system design process technique, agile, is applied, and a system is developed based on the requirement and analysis of agile based game design process.

Fig. 1. Text-based RPG[1] and Map-based 2D RPG.[2]

2. FINDING THE SOLUTION

Since Role-playing games (RPG) are popular not just in game design but also in other disciplines, there are various researches in many diverse directions. Briefly, Role-playing game research that provides inspiration for this research can be further divided into three groups.

(1) Modifiable game script: Generative design patterns (GDPs) are often used for the RPG script.[3] There will be a core program of the game and let designers to edit the information of the games directly.

(2) Game modular approach. For example, using different operating platforms to set up the game operation for playing,[4] and modulating the design of game can increase the ease of altering the game content.[5]

(3) Game design paradigm, such as how to design a game and research,[6] or how to design characters.[7]

2.1. Case Studies

The major game design supporting tools for RPG games are RPG Maker series,[2] RPG Manager and Open RPG Maker. On these three development platforms, the amount of design modules and the items of equipment are quite large. Unused attribute parameters in the design stage of game characters occupy amount of space and the equipment types of roles are mostly fixed and unchangeable. In addition, the capacity of the equipment can only be designed with fixed values. It results the limitation in designing the background, characters, and equipment.

The items in database are presented in a simple list-form including the characters, props, skill, variables, and trigger events. When designing a big-mode game, over 50 items, for example, will occur in the database, and will thus cause difficulties in finding and setting data. It will also increase the complication for designers to search a variable or set determination so as to avoid the information included in development interface.

UI in the game developed by these tools are basically not easily to change except the basic frame and background, even the display of information to the players are fixed. If designers want to modify some parameters, they need to do the scripting of the game, and this will need the extra knowledge of programming.

2.2. Our Approaches

In order to solve the above issues: four requirements are (1) lower down the difficulty for game programming, (2) improve the details of module, (3) increase the specialty in equipment, (4) reduce the complication of data and information. Two strategies are applied: Modular and agile software development.

For improving the granularity and scalability of module, the RPG elements are classified. Then using an object-oriented approach to design in part of a modular design. The purpose is giving designers a basic component library on game development, such that they can create new objects. Meanwhile, modular, with enough details, can solve the problem of difficult to master game programming. Because when you are doing modular visually, the game's code will be modular as well.

Changes in the interface of game will take advantage of the modular to design, makes the changes in game of the configuration menu improved. In the part of what information does the players seen, the information will be changed with the different modules.

To increase the features of the equipment and props, we make a new editor on the development platform. Thus operators can increase bonus of equipment property by formula and equipment increased variability. It lets props' characteristics link to the event to find extra characteristics and peculiarities. Part of the event editor, we will consist the event group of commonly used event, little game, and puzzle games. Therefore, it can reduce the burden on the designer. To make the structure and content be easier to expand, we will use Xml format on map, modules, database and storage triggering event.

2.3. Agile Software Development

Agile development method is to help software developers manage and accelerate the speed of designing software.[8] This can transfer the traditional design process as an iterative cycle that suitable for the game design process in our scope. Agile allows us to find the discipline of the complex information. For example, the information displays in the general development programs is cluttered as Figure 2 (left). After the use of agile, the information is organized into blocks like Figure 2 (right), and the information of each block can be edited individually and the blocks can be connected by information. The process will allow design tasks be clear and effective.

Furthermore, using an agile development pattern to help designers manage and design game paradigm is using its characteristics that will transform designer's every idea of the game into a task, and each task works separately in order to reduce the complexity of information on development interface. At the same time, we can protect the completed part from modifying.

3. SYSTEM ANALYSIS

We have to solve the problem described above will be divided into four steps, including (1) To identify and classify the RPG elements of item, (2) Planning module to segment content, (3) Systems analysis and design, (4) To assess the degree of freedom in these four steps.
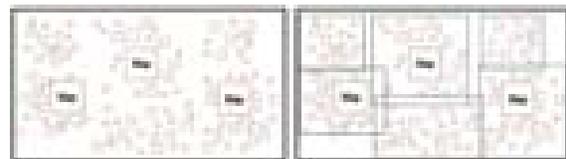

Fig. 2. Data presented: generally editor and after collation.

Automatic Generation of 3D Building Models by Rectification of Building Polygons

Kenichi Sugihara[1,*] and Zhen-Jiang Shen[2]

[1]*Gifu Keizai University*
[2]*Kanazawa University*

A 3D city model is important in urban planning and game industries. But, enormous time and labour has to be consumed to create these 3D models. In order to automate laborious steps, a GIS (Geographic Information System) and CG integrated system is proposed for automatically generating 3D building models, based on building polygons on a digital map. Since technicians are drawing these polygons manually with digitizers, depending on aerial photos, not all building polygons are precisely orthogonal. However, creating 3D building models are expected to be orthogonal. When placing a set of boxes as building bodies for creating the buildings, there may be gaps or overlaps between these boxes if building polygons are not precisely orthogonal. In this paper, the new methodology is proposed for rectifying the shape of building polygons and generating 3D building models without any gap and overlap.

Keywords: 3D City Model, Automatic Generation, GIS (Geographic Information System), 3D Building Model, Building Polygon, Rectification.

1. INTRODUCTION

A 3D urban model, such as the one shown in Figure 1 right, is important in urban planning and gaming industries. Urban planners may draw the maps for sustainable development. 3D urban models based on these maps are quite effective in understanding what if this alternative plan is realized. However, enormous time and labour has to be consumed to create these 3D models, using 3D modelling software such as 3ds Max or SketchUp. In order to automate laborious steps, a GIS (Geographic Information System) and CG integrated system was proposed for automatically generating 3D building models, based on building polygons or building footprints on a digital map shown in Figure 1 left.[9, 10]

A complicated orthogonal polygon can be partitioned into a set of rectangles. The proposed integrated system partitions orthogonal building polygons into a set of rectangles and places rectangular roofs and box-shaped building bodies on these rectangles. In order to partition an orthogonal polygon, a useful polygon expression (RL expression: edges' Right and Left turns expression) and a partitioning scheme was proposed for deciding from which vertex a dividing line (DL) is drawn.[11]

Since technicians are drawing building polygons manually with digitizers, depending on aerial photos or satellite imagery as shown in Figure 1 left, not all building polygons are precisely orthogonal. When placing a set of boxes as building bodies for forming the buildings, there may be gaps or overlaps between

these boxes if building polygons are not strictly orthogonal. Our contribution is the new methodology for rectifying the shape of building polygons and constructing 3D building models without any gap and overlap.

In our proposal, after approximately orthogonal building polygons are partitioned and rectified into a set of mutually orthogonal rectangles, each rectangle knows which rectangle is adjacent to and which edge of the rectangle is adjacent to, which will avoid unwanted intersection of windows and doors when building bodies combined.

2. RELATED WORK

Since 3D urban models are important information infrastructure that can be utilized in several fields, the researches on creations of 3D urban models are in full swing. Various types of technologies, ranging from computer vision, computer graphics, photogrammetry, and remote sensing, have been proposed and developed for creating 3D urban models.

Procedural modelling is an effective technique to create 3D models from sets of rules such as L-systems, fractals, and generative modelling language.[8] Müller et al.[5] have created an archaeological site of Pompeii and a suburbia model of Beverly Hills by using a shape grammar that provides a computational approach to the generation of designs. They import data from a GIS database and try to classify imported mass models as basic shapes in their shape vocabulary. If this is not possible, they use a general

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Effect of Immersion Time on the Growth of ZnO on PMMA-Coated Substrate Prepared by Solution-Immersion Method

A. Aadila[1,2,*], N. A. M. Asib[1,2], A. N. Afaah[1,2], M. R. Mahmud[1,2], F. S. Husairi[1,2], Salman A. H. Alrokayan[4], Haseeb A. Khan[4], R. Mohamed[1,3], M. Rusop[1,3], and Z. Khusaimi[1,2]

[1]*Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia*
[2]*NANO-SciTech Centre, Institute of Science, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia*
[3]*NANO-Electronic Centre, Faculty of Electrical Engineering, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia*
[4]*Research Chair of Targeting and Treatment of Cancer Using Nanoparticles, Department of Biochemistry, College of Science, King Saud University, Riyadh 11451, Saudi Arabia*

We present the growth of ZnO on PMMA-coated substrate under influence of different immersion time by solution-immersion technique. PMMA polymer was coated on the substrate by spin-coating method. The sample was then prepared for PMMA thin film and immersed for four (4) and six (6) hours in zinc solution. FESEM result shows the morphology of PMMA thin films and rod-like structure of ZnO was obtained after ZnO grow on PMMA. EDX analysis confirms the existence of ZnO and PMMA contains in the sample. The structural properties were studied by Raman Spectra and the optical properties were characterized using Photoluminescence (PL), and Ultraviolet-Vis (UV-Vis) spectroscopy. It was found that shorter time of immersion (4 hours) produced higher intensity of PL and Raman. From UV-Vis measurement 4 hours of immersion indicate the low absorption probably caused from the distribution of ZnO on PMMA-coated substrate is randomly dispersed. However, 4 hours of immersion be chosen in this UV measurement because the sample is more crystalline and may have small size of ZnO. It showed that the optical properties was significantly affected by the surface morphology and the scattering light efficiently is very dependent on particle distribution of the films.

1. INTRODUCTION

Organic–inorganic combinations are of great interest, owing to their excellent structural and optical properties.[1,2] A number of recent researchers have introduced the organic–inorganic combinations by embedding inorganic particles into polymer matrix. These combinations tender a path for a new class of material which inherent in properties of both inorganic particles and organic polymers.[3] Have been reported that nanostructured materials are highly expensive to manufacture and difficult to process and shape while polymers offer a flexible lightweight materials, easy to processed and shaped which can be produced at a low cost.[3] Therefore, it could be observed that organic–inorganic combinations complement to each other and may produce unique optical, mechanical, thermal and electrical properties that are associated with broad applications. For example in UV applications, the suitable inorganic particles-polymer matrix can represent a synergetic collaboration between

UV-absorbing inorganic materials like ZnO and transparent polymeric matrix like poly(methyl methacrylate) (PMMA).[4,5] Preparation of PMMA-based polymeric films by incorporating some wide-band-gap semiconductor fillers like TiO_2, ZnS, and ZnO into polymer matrix due to that the PMMA not only has a high transparency throughout the visible range but also can itself strongly absorb the deep ultraviolet (DUV) of wavelength less than 300 nm.[4,6] In addition, ZnO are known as most promising UV-absorbing materials which can be implanted dispersedly into the PMMA matrix to achieve a homogenous film, which hardly scatter any visible lights, thus retain high optical transparency.[4]

In recent years, the synthesis of zinc oxide has received considerable attention owing to the many interesting and unique properties like a wide direct band gap of 3.37 eV and a large exciton binding energy of 60 meV which is much larger than those of GaN (24 meV), ZnSe (19 meV) and ZnS (39 meV).[3,7–10] Due to this unique properties, the exciton is stable at room temperature even in bulk crystals.[3] So far, there have been many of studies the ZnO in the form of thin films. This is due to the ZnO thin

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*Author to whom correspondence should be addressed.

Harmonic Potential Function Based Algorithm for Autonomous Mobile Robot Navigation

Subbash Panati, Bayanjargal Baasandorj, and Kil To Chong*

Department of Electronics and Information Engineering, Chonbuk National University, Jeonju, South Korea

Autonomous mobile robot navigation consists of two key features path planning and obstacle avoidance. This paper presents a harmonic potential function based algorithm for autonomous navigation of mobile robot. Harmonic potential functions are used to generate a type of potential field called Harmonic potential field. Due to the properties of Harmonic functions, harmonic potential field method has the ability to overcome the local minima problem which was a major drawback of artificial potential method. Harmonic functions and boundary conditions are the two main components of harmonic potential field. In the proposed method Harmonic functions are used to compute harmonic potential field and Dirichlet boundary conditions are used to represent the obstacles, initial position and goal position respectively. The simulation results show that the proposed method overcomes the issue of local minima and enables the robot to navigate efficiently from the initial position to the goal position without any collisions into the obstacles in static environment.

Keywords: Autonomous Mobile Robot, Harmonic Potential Field, Obstacle Avoidance, Path Planning.

1. INTRODUCTION

Autonomous mobile robot navigation is a classical problem in the field of mobile robotics. In the past three decades the research on Autonomous mobile robot navigation has been carried out intensively, leading to development of many types of algorithms intended to solve the path planning and obstacle avoidance tasks in mobile robot navigation. Some of the most commonly used algorithms are artificial potential field algorithm, Vector field histogram method, bug algorithm etc. The algorithms that has been devised fall into one of the following three categories: Exact, Heuristic, Grid algorithms.[1] Visibility graphs, Vornoi diagrams fall under the exact algorithms class. They provide a mathematically efficient way of finding the best solution. Bug algorithm falls under the Heuristic algorithms class which is simple from the implementation perspective and is well suited for static environments. Potential field algorithms fall under the class of grid based methods which are more efficient in practical usage. Artificial potential field method for mobile robot navigation proposed by Borenstein et al.[2] has been one of the most used navigation scheme. The core principle of this scheme is based on attractive and repulsive potential field concepts. The goal point is assumed to be negatively charged and rest other elements in the working environment of the robot like the obstacles and the initial point of the robot are assumed to be positively charged. The magnitude of the attractive or repulsive potential field is calculated based on the

distance between the robot and the goal or the obstacles respectively. The attractive feature of the artificial potential field method is its simplicity and elegance with respect to mathematical analysis. The main bottleneck of the artificial potential field methods lies in its inability to counter the issue of local minima in the working environment. Local minima is a condition where in the magnitude of the attractive potential field and repulsive potential field is equal. This situation leads to the robot getting stuck in a position and being not able to compute its next move. In order to overcome the issue of artificial potential field, Conolly et al.[3] proposed harmonic potential filed method. Harmonic potential filed method is a novel artificial function based on harmonic functions, which overcomes the limitations of potential field methods. Harmonic functions are solution to Laplaces equations. The most important property of harmonic functions is that they are free from local minima.[4–6] The core idea of this method lies in creation of only one minimum in the working environment i.e., the global minimum which is represented by the goal. If the goal is represented by a global minimum and no other minimum exists in the environment then the robot will arrive at the goal location always. Harmonic potential field algorithm has gained a lot of interest in mobile robot navigation due to its distinct feature of avoiding local minima and it also produces a smooth path for mobile robot navigation.[7] Unlike potential field methods, harmonic potential field method not only performs well in static environment but also works efficiently in dynamic environment and can cope the rapid changes in the environment. Some

*Author to whom correspondence should be addressed.

of the research articles related to the use of harmonic potential field for mobile robot navigation are mentioned as follows, Kalavsky et al.[8] have explained the mechanism to generate potential field using harmonic functions and to formulate a algorithm for computing a safe path for mobile robot in the environment with created potential field. Keymeulen et al.[9] have presented the effect of boundary conditions for the obstacles. The application of potential field method for autonomous ground vehicles has been presented in Refs. [10–15]. This paper presents a path planning of a differential wheel drive mobile robot using harmonic potential field approach, Dirichlet boundary conditions are used to specify the boundary values for the obstacles. Simulation is carried out to evaluate the proposed method, Matlab software has been used for setting the boundary conditions and generating the environment for implementation of harmonic potential field method. The simulation results shows the effectiveness of the proposed approach.

The organization of the paper is as follows. Kinematics modelling of the robot is discussed in Section 2. The description of harmonic potential field is discussed in Section 3. Simulation results are discussed in Section 4. Discussion and conclusion are presented in Section 5.

2. KINEMATIC MODELING OF WHEELED MOBILE ROBOT

A two wheeled differential drive, non holonomic robot has been used in this research work. The geometrical representation of the mobile robot is shown in Figure 1. It is assumed that the robot moves in a horizontal plane, the wheels of the robot are not deformable, the mobile robot moves without skidding, sliding or slipping, wheels are connected by a rigid frame. The two wheels are independently controlled by actuators to achieve the desired motion and orientation. The kinematic model of the mobile robot is given in Eq. (1),

$$\begin{pmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{pmatrix} = \begin{pmatrix} V\cos\theta \\ V\sin\theta \\ \omega \end{pmatrix} \qquad (1)$$

3. HARMONIC POTENTIAL FIELD

Potential field methods are based on the concept of electrostatics where, the goal is assumed to be negatively charged and
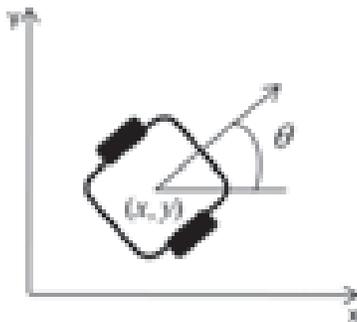

Fig. 1. A two wheeled non-holonomic mobile robot.

exerts attractive potential field where as obstacles in the environment are assumed to be positively charged and exerts repulsive potential field. Potential field methods use reactive approach in which trajectories are not planned explicitly. Instead, agents interaction with the environment are superposed to make the robot flexibly cope with the changing environment. Potential fields are mainly comprised of force vectors caused by obstacles and goal positions. The force vectors can be linear or tangential or they also can possess characteristics of attractive or repulsive forces depending on the state of the agent with respect to the environment.

Harmonic Potential field method is a novel method based on harmonic functions, it overcomes the limitations of Potential field methods. The most important trait of harmonic potential field method is that they are free from local minima. Harmonic potential field method uses harmonic functions and boundary value conditions to overcome the local minima problem. To build an artificial potential, we use harmonic function. A harmonic function should satisfy Laplaces equation, it should not have local extrema in a space free from singularities, it should have second order derivatives. Solution of laplace equation is also known as the mobile robot velocity potential:

$$V = -\nabla\Psi_{i,j} = \begin{pmatrix} V_x \\ V_y \end{pmatrix} = -\begin{pmatrix} \dfrac{\partial\Psi_{i,j}}{\partial x} \\ \dfrac{\partial\Psi_{i,j}}{\partial y} \end{pmatrix} \qquad (2)$$

A harmonic function should also satisfy principle of superposition and principle of maxima and minima. These principles indicate that the harmonic function has its extremes only on the boundary, so it does not have local maxima/minima inside the boundary. Hence, it is convenient for us to define boundary conditions for boundary of all obstacles and boundary of goal. In this research Dirichlet boundary conditions have been used. The Dirichlet boundary condition states that the boundary of all obstacles will be assigned with the maximum value in the region and the boundary of goal position has the minimum value in the region. By defining the boundary conditions in this format the potential field is harmonic field with only global minimum represented by goal position.

3.1. Finite Difference Approximation Method

Finite difference approximation method, Finite element method, finite volume method are some of the methods used to find the numerical solutions to Laplace equations. The finite difference approximation has been used in the proposed research to find the numerical solution of Laplace equation. A finite difference is a technique in which the derivatives of the partial differential equations are approximated by linear combinations of function values at grid points. The approximation of derivatives by finite differences plays a central role in finite difference methods for the numerical solution of differential equations, especially boundary value problems. The main advantage of using finite difference approximation method lies in its simplicity to implement and can be used to obtain numerical solution of partial differential equation (PDE).[16] A grid is used to divide the region of interest. Since the PDE is satisfied at each point in the area, it must be satisfied at each point of the grid. By using segmentation of environment, we can obtain potential distribution of the environment as shown in Figure 2.
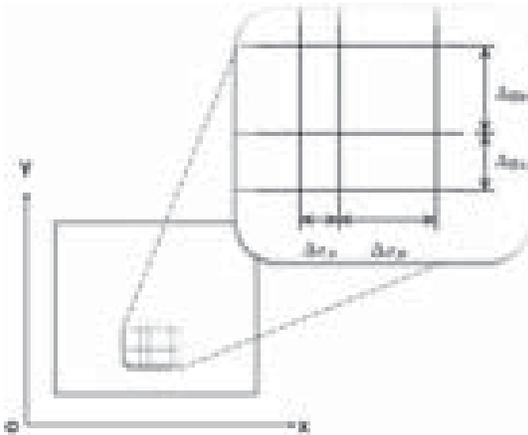
Fig. 2. Sub-region of potential distribution in the environment.

In order to solve finite difference approximation for the derivative ψ_{xx} we use the following equations:

$$\Psi_{i-1,j} = \Psi_{i,j} - T_x \Delta x_A + \frac{1}{2}\Psi_{xx}\Delta x_A^2 \qquad (3)$$

$$\Psi_{i+1,j} = \Psi_{i,j} - T_x \Delta x_B + \frac{1}{2}\Psi_{xx}\Delta x_B^2 \qquad (4)$$

Subtracting equation Eqs. (3) and (4), and solving for $\Psi_x = \partial\Psi/\partial x$ while neglecting the terms involving $\Psi_{xx} = \partial^2\Psi/\partial x^2$, results in

$$\Psi_x = \frac{\Psi_{i+1,j} - \Psi_{i-1,j}}{\Delta x_A + \Delta x_B} \qquad (5)$$

Adding equations Eqs. (3) and (4), and solving for $\Psi_x = \partial\Psi/\partial x$, after replacing the expression for Ψ_x, from Eq. (5), results in the following expression:

$$\Psi_{xx} = 2\left(\Psi_{i-1,j} + \Psi_{i+1,j} - 2\Psi_{i,j} \right.$$
$$\left. + \frac{(\Psi_{i+1,j} - \Psi_{i-1,j})(\Delta x_A - \Delta x_B)}{(\Delta x_A + \Delta x_B)}\right) \times (\Delta x_A^2 + \Delta x_B^2)^{-1} \quad (6)$$

To simplify the expression we introduce the following definitions:

$$\alpha_x = \Delta x_A - \Delta x_B, \quad \beta_x = \Delta x_A + \Delta x_B, \quad r_x = \frac{\alpha_x}{\beta_x}$$
$$\gamma_x^2 = \Delta x_A^2 + \Delta x_B^2 \qquad (7)$$

Thus

$$\Psi_{xx} = \frac{2(\Psi_{i-1,j} + \Psi_{i+1,j} - 2\Psi_{i,j} + r_x(\Psi_{i+1,j} - \Psi_{i-1,j}))}{\gamma_x^2} \qquad (8)$$

Similarly, we can obtain the following equation Ψ_{yy} for the following derivatives in y:

$$\Psi_{yy} = \frac{2(\Psi_{i,j-1} + \Psi_{i,j+1} - 2\Psi_{i,j} + r_x(\Psi_{i,j+1} - \Psi_{i,j-1}))}{\gamma_y^2} \qquad (9)$$
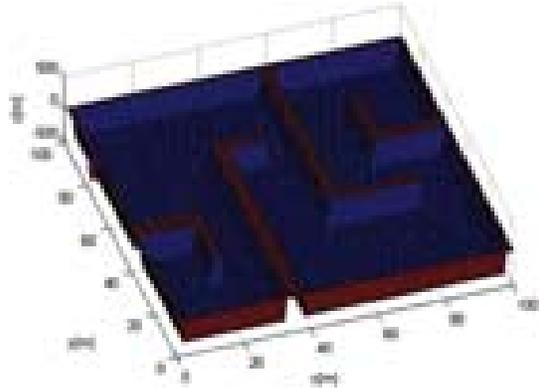

Fig. 3. Simulation environment.

If we now replace the results of Eqs. (8) and (9) into the Laplace equation $\Psi_{xx} + \Psi_{yy} = 0$, results in the following finite-difference approximation:

$$\frac{2(\Psi_{i-1,j} + \Psi_{i+1,j} - 2\Psi_{i,j} + r_x(\Psi_{i+1,j} - \Psi_{i-1,j}))}{\gamma_x^2}$$
$$+ \frac{2(\Psi_{i,j-1} + \Psi_{i,j+1} - 2\Psi_{i,j} + r_x(\Psi_{i,j+1} - \Psi_{i,j-1}))}{\gamma_y^2} = 0$$

An explicit solution for the value of the unknown $\Psi_{i,j}$ at the center of the computational cell can be obtained from above equation:

$$\Psi_{i,j} = \frac{\gamma_y^2(\Psi_{i-1,j} + \Psi_{i+1,j} + r_x(\Psi_{i+1,j} - \Psi_{i-1,j}))}{2(\gamma_x^2 + \gamma_y^2)}$$
$$+ \frac{\gamma_x^2(\Psi_{i,j-1} + \Psi_{i,j+1} + r_y(\Psi_{i,j+1} - \Psi_{i,-1}))}{2(\gamma_x^2 + \gamma_y^2)} \quad (10)$$

If we consider a rectangular region where the increments in both x and y are uniform which means

$$\Delta x_A = \Delta x_B = \Delta x, \quad r_x = \alpha_x = 0$$
$$\Delta y_A = \Delta y_B = \Delta y, \quad r_y = \alpha_y = 0$$
$$\beta_x = 2\Delta x, \quad \gamma_x^2 = 2\Delta x^2$$
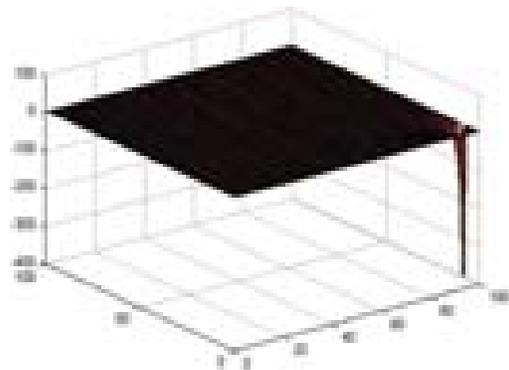$$\beta_y = 2\Delta y, \quad \gamma_y^2 = 2\Delta y^2$$
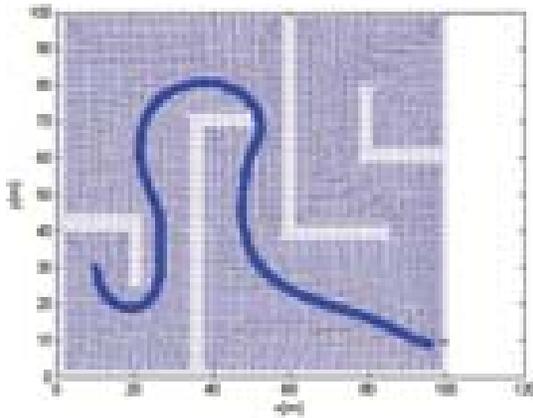

Fig. 4. Potential field.

Fig. 5. Mobile robot navigation: Scenario-1.

and Eq. (10) simplifies to

$$\Psi_{i,j} = \frac{\Psi_{i-1,j} + \Psi_{i+1,j} + \Psi_{i,j-1} + \Psi_{i,j+1}}{4} \qquad (11)$$

4. SIMULATION

A two wheel differential drive mobile robot has been used for the implementation of proposed algorithm. The direction of navigation of mobile robot is controlled by the potential field generated by the Harmonic potential function and also based on dirichlet boundary conditions. The area of the simulation environment is considered to be 100×100 metres. The simulation environment is modelled with static obstacles (walls), the mobile robot is required to traverse through these obstacles from initial position to reach the goal position (see Fig. 3). Dirichlet Boundary conditions has been used to assign boundary conditions for the obstacles, initial and final positions. In order to evaluate the performance of the proposed method two scenarios are considered where in the mobile robot is tested with different initial and final positions. Harmonic potential field method has the ability to generate path for any given initial position and any given target point of the mobile robot. Figures 4 and 6 shows the potential field distribution in the environment for the two scenarios Figures 5 and 7 shows the path which the robot followed to reach the target
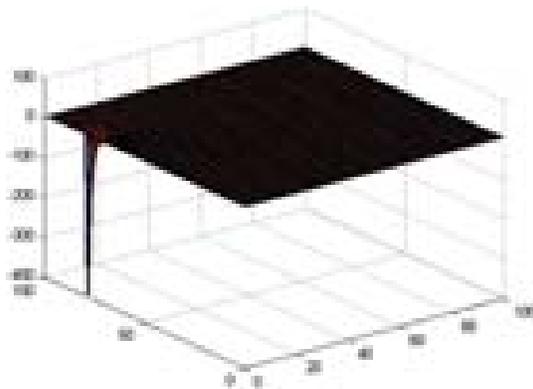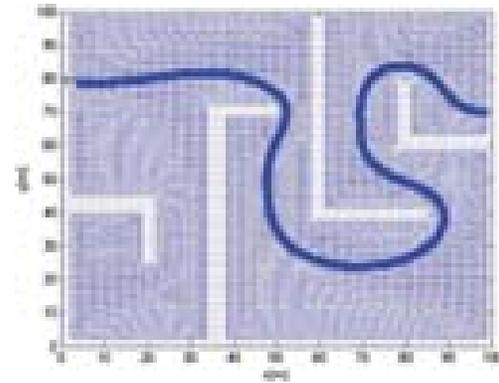

Fig. 6. Potential field.

Fig. 7. Mobile robot navigation: Scenario-2.

and displays the result of the proposed method in this paper. It can be observed that the mobile robot could safely avoid obstacles and successfully navigate towards the goal position in both the scenarios.

In the first scenario, the initial position and target position of the robot are assigned to be (10,30) and (97,09) respectively. The potential field distribution in the environment for the second scenario is shown in Figure 4. The simulation results for the second scenario is shown in Figure 5.

The simulation results of the second scenario are shown in Figure ??, in this scenario the initial position is considered to be (98,70) and goal position is considered to be (3,79). The potential field distribution in the environment for the second scenario is shown in Figure 6. The simulation results for the second scenario is shown in Figure 7.

5. DISCUSSION

This paper presents a harmonic potential field based navigation scheme for mobile robots. The potential fields are generated using the Laplaces equation, Dirichlets conditions are used to specify the boundary conditions for the obstacles, Initial and goal positions. Finite difference approximation method is used to find the numerical solution of laplace equation. The proposed method has been evaluated in matlab. In order to evaluate the efficiency of the proposed algorithm, two types of simulation scenarios with different initial and goal points have been considered. It can be observed from the simulation results that the streamlines generated by the harmonic potential field method is smooth and it enables the robot to completely avoid the obstacles and efficiently reach the goal position in static environment.

6. CONCLUSION

A mobile robot navigation algorithm using Harmonic Potential function has been presented in this research paper. The performance of algorithm has been tested in static environment using a differential drive mobile robot. Two scenarios with different initial position and goal position were considered and mobile robot navigation based on harmonic potential field was simulated in matlab environment. The simulation results show that harmonic potential field has the ability to overcome the Local minima issue and enables the mobile robot to navigate autonomously through the obstacles in static environment.

Instructional Design in Serious Game for Learning Based on Inquiry and Situated Learning Theory

Ririn Dwi Agustin[1,2,*], Ayu Purwarianti, Kridanto Surendro, and Iping Supriana Suwardi[1,2]

[1]*School of Electrics and Informatics Engineering, STEI ITB, Indonesia*
[2]*Ganeca, Bandung West Java*

Digital game for learning or Serious Game for Learning (SGfL) need to be developed and refined at many level of abstraction, in particular to address concerns from education experts about aspects of learning are applied in the gaming interaction. This paper will explain about learning model that comply to be implemented in (SGfL) to make its design can be accounted for pedagogics and for high flexibility in subject/domain that be learned. Instructional design that suitable with cause-effect flow model (from Mihalyi) are inquiry based learning with flexible guidance and situated learning within meaningful learning context. Question or problem based in inquiry model was suitable with task based in flow model. Situated learning that need autothelic learning context is have same concept with immersion, especially about modeling reality. Transformation the instructional model into game design was inspired by The SIM Career. The proposed SGfL's genre is role playing and simulation of life game as profesional. TASK was transformed into working. For life, player must work. For get job position, player must have a competency certificate through Training. In working, player must complete a task. By completing the task, player learning by doing. The elements in the gameworld design adapted to the field of work, so that the player feels like working on a real-world environment. From this point can be concluded that gameworld could not be domain independent, because environment of working is dependent on the domain learned (learning context). The task completion interaction was managed like quiz or test in Moodle. It was not soo good from immersion aspect but high flexibility, so can be domain independent.

Keywords: Serious Game, Learning Model, Inquiry Learning, Situated Learning.

1. INTRODUCTION

Pedagogical aspects in the game for learning is a hot issue. Education experts sharply criticized the pedagogical aspects in edugame. Serious games for learning (SGfL) is a movement of the game developers to address these challenges.

This paper does not describe the game from the aspect of its ability in generating motivation to learn but rather explores the learning model or instructional design to be applied within a SGfL. In pedagogics, before running the learning, it must be done the planning process to ensure that learning will be efficient, effective, and appealing. The planning was mention as instructional design (ID) document. Dick and Carey[1] declared that ID consist of (a) learning outcome (b) learner context (c) learning context (d) performance objective (e) assessment instrument (f) learning content (g) instructional strategy (h) evaluation.

Instructional strategy consist of (1) organizational strategies, are talk about how the lesson be properly arranged and sequenced (2) delivery strategies on how information is carried to the student. It is more about media for delivery (3) management

strategies are design about how the learners interact with learning activities to increase knowledge or skill or emotion.

From three elements of instructional strategies, in this paper will discussed about management and organizational strategies with DIGITAL GAME as delivery strategies. The purpose of this research is develop desain learning model equal with instructional design that will be implemented in game desain elemen of SGfL. The SGfL in this paper focus on adult learner, with domain independent in learning content and learning context, and independent from type and level of learning outcome.

The methodology in this research are literature study, conceptual analysi, s/w product exploration, and then desain model. Case study was conducted as instance for evaluate the model of game design.

2. LITERATURE REVIEW

2.1. Cause-Effect Model of Flow Theory and Game Design Element

As was described at Figure 1, it has been concluded that the task is challenging, clear goals, immediate feedback, cognitive feedback,

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*Author to whom correspondence should be addressed.

Distributed Control System Design for Sorting Parts System Based on PC and PLC

Chuan Lian Zhang[1], Dazhi Huang[2], Qinggui Zhou[2], and Kil To Chong[1, 3, *]

[1]*Chonbuk National University, Jeonju, South Korea*
[2]*HUAIHAI Institute of Technology, Lianyungang, 222005, China*
[3]*Advanced Electronics and Information Research Centre, CBNU, Jeonju, Korea*

This paper presents the design of distributed control system for sorting parts system based on PC and PLC, which adopts RS485 communication. With development of technology, many developed and multifunctional control systems have been applied. However, high investment and robustness problems confine them to be widely adopted in comparison with distributed control system. In this paper, one PC is chose to be the master station to monitor and control slave stations which are PLCs. Monitoring software of master station is developed using VB6.0 for data input/output, flow control and online parameters setting. RS485 communication is the bridge between monitoring software and PLCs. All these functions are validated by experiments. Experiments results show that control system is robust and practical.

1. INTRODUCTION

In terms of industrial control, there are three common control system: distributed control system (DCS), fieldbus control system (FCS) and intelligent control-maintenance-technical management system (ICMMS). The last two systems are suitable for medium and large control system which can provide kinds of functions for whole factory management. But they need large investment and robustness is a serious problem of them. Comparing to FCS and ICMMS, DCS still is dominant among industrial control system, wherein control elements are distributed throughout the system. Its structure looks like a tree where a hierarchy of controllers is connected by communications networks for command and monitoring.[1, 2]

DCS always chooses high-performance control device Programmable logical controllers (PLCs) as slave stations.[3] Touch panels, Supervisory Control and Data Acquisition (SCADA) software and universal software platform such as visual basic 6.0 (VB6.0) are the most three popular platforms to monitor PLCs. Each platform has advantages and disadvantages. Though touch panel has limited functions, communication problems is out of consideration; obviously, multifunction is the biggest advantage of SCADA, nevertheless, high price confined its access to small and medium control system. Monitoring software developed on universal software platform can customize for some small and medium-scale production systems but it needs to consider communication problems.[4] In order to solving these problem, using

senior program platforms to develop a more applicable and economical communication program to monitor production system is becoming increasingly popular. Therefore, it has great practical significance to find a highly efficient and cost-effective communication method. RS232, RS422 and RS485 are the most three common communication ways between PLCs and PC.[5] Only RS485 can be used effectively over long distance and in electrically noisy environments. That is the reason why this paper choose RS485 communication and VB6.0 to design whole distributed control system monitoring software. There are many similar works. For example, one group adopts a combination of VB6.0, FX_{2N} PLCs and RS232[6] while another group's combination using RS-422.[5] Other works achieved same goals using different brand PLCs.[7, 8]

The innovation of this project is proposing the combination of Vb6.0, FX_{2N} PLCs and RS485 communication. Hardware design is mainly about design the sorting parts system by using classical components such as conveyor belts, sensors and manipulators. Software design can be divided into two parts: developing monitoring software using VB6.0 and programming for PLCs. The connections between hardware and software are implemented by RS485 communication. Multiple receivers can be connected to this network in a parallel way. Some experiments were performed on this experimental automatic production line to show performance of whole control system. As a result, the monitoring software successfully controls the automatic production line. Therefore, it has great significance on application of practical automatic production line.

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*Author to whom correspondence should be addressed.

Influence of Different Molarity Concentrations of TiO$_2$ Seeded-Template to the Growth of Nanostructured ZnO

N. A. M. Asib[1,2,*], A. N. Afaah[1,2], A. Aadila[1,2], M. R. Mahmud[1,2], Y. C. Lim[1],
Salman A. H. Alrokayan[4], Haseeb A. Khan[4], M. Rusop[2,3], and Z. Khusaimi[1,2,*]

[1]*Faculty of Applied Sciences;* [2]*NANO-SciTech Centre, Institute of Sciences;* [3]*NANO-ElecTronic Centre, Faculty of Electrical Engineering,*
Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia
[4]*Research Chair of Targeting and Treatment of Cancer Using Nanoparticles, Department of Biochemistry, College of Science,*
King Saud University, Riyadh, 11451, Saudi Arabia

This work reports a study on two different preparation methods for TiO$_2$ seeded-templates and ZnO nano-structures. Firstly, deposition of TiO$_2$ seeded-templates via solution-immersion method on TiO$_2$ seed layers. Solution of TiO$_2$ at different molarity concentrations were prepared and coated on glass substrates until seven layers of TiO$_2$ for each molarities, followed by annealing treatment and solution-immersion process in aqueous solution containing 1:1 ratio of 0.05 M of zinc nitrate hexahydrate (Zn(NO$_3$)$_2$·6H$_2$O) and hexamethylenetetramine (HMTA) (C$_6$H$_{12}$N$_4$). FESEM images of fabricated ZnO nanostructures grown on TiO$_2$ seeded-template shows needle-like shape with smaller tip. The optical properties of the nanostructures thin films are observed by PL and UV-Vis. Intensity of PL emission and absorption properties at UV region are seemingly affected by varying the molarity concentrations of TiO$_2$ seed layer.

1. INTRODUCTION

Zinc oxide (ZnO) is a direct band gap semiconductor with hexagonal wurtzite crystal structure, having good optical and electrical properties including has a wide band gap of 3.37 eV, large exciton binding energy about 60 meV and has high refractive index of 2.01.[1] ZnO exhibit many unique optical and electrical properties which makes them very attractive in various technological fields such as optical and optoelectronic devices;[2] solar cell, UV shielding material, photocatalyst, and UV sensor. The performances of these devices are mainly related to the morphology, structure and dimension of ZnO nanostructures.[3] For example, the performance of the ZnO based UV sensor can be improved by the surface modification, nanorod size, surface area, film thickness, and surface defects of ZnO. The process of modifying the surface of ZnO is related to the surface adsorption of gas molecules from the atmosphere and surface defects, which influence the characteristics of sensor. Therefore, an approach of utilizing the catalytic seed layer to growth better ZnO was used as this seed layer can act as nucleation centres to prepare a suitable site to which ZnO nanostructures can adhere since it can provide an almost mismatch-free interfacial layer between the ZnO and the

seed layer so that well aligned of ZnO nanostructures can grow. In addition, the seed layer can assist an epitaxial growth process on the seed layer coated on glass substrate.[4]

Titanium dioxide (TiO$_2$) is a material that belongs to the group of metal oxide. It can be a good candidate of seed layer due to its excellent properties such as good semiconductor properties, high chemical stability, high photocatalytic activity, non-toxicity[5] and long thermal photostability.[6] Besides, TiO$_2$ has a wide direct band gap of 3.0 eV or 3.2 eV in the rutile or anatase crystalline phase which is similar to ZnO. However, ZnO is a direct band gap semiconductor but TiO$_2$ is an indirect band gap semiconductor with a relative lower cost.[7,8] Moreover, TiO$_2$ can act as catalytic promoter during the involved reaction[9] and can greatly modified the physical and optical properties of thin films when we introduce it into ZnO matrices.[10,11]

Nanostructures of ZnO can be produced by several methods such as spray pyrolysis,[12] chemical vapour synthesis (CVS),[13] pulsed laser deposition, and solution-based method. In particular, the advantages offered by solution-based method over other techniques include synthesizing nanostructured ZnO at low processing temperature and low cost, simplicity of the experimental method of preparing a large-area thin film with excellent compositional control, and well suited for large-scale production of ZnO.[14]

*Authors to whom correspondence should be addressed.

Corrosion Protection Study of Mild Steel Coated with Acrylate:Carbon Nanotubes Nanocomposite Investigated by Electrochemical Impedance Spectroscopy

M. R. Mahmud[1, 2, *], M. M. Akhir[1, 2], M. S. Shamsudin[1, 2], A. Aadila[1, 2], A. N. Afaah[1, 2], N. A. M. Asib[1, 2], Salman A. H. Alrokayan[4], Haseeb A. Khan[4], M. K. Harun[1], M. Rusop[2, 3], and S. Abdullah[1]

[1]*Faculty of Applied Sciences, Universiti Teknologi MARA (UiTM), 40450 Shah Alam, Selangor, Malaysia*
[2]*NANO-SciTech Centre, Institute of Science, Universiti Teknologi MARA (UiTM),*
40450 Shah Alam, Selangor, Malaysia
[3]*NANO-ElecTronic Centre, Faculty of Electrical Engineering, Universiti Teknologi MARA (UiTM),*
40450 Shah Alam, Selangor, Malaysia
[4]*Research Chair of Targeting and Treatment of Cancer Using Nanoparticles, Department of Biochemistry,*
College of Science, King Saud University (KSU), Riyadh, 11451, Saudi Arabia

The corrosion protection of acrylate:carbon nanotubes (A:CNTs) nanocomposite thin film has been coated on mild steel characterised by electrochemical impedance spectrometer (EIS) measurement and equivalent circuit model are employed to analyse coating impedance for corrosion protection. In this study, 3.5 w/v% sodium chloride (NaCl) solution was used to immersed the A:CNTs nanocomposite thin film. From EIS measurement, A:CNTs nanocomposite thin film with 0.4 w/v% contain of CNTs was exhibited the highest coating impedance from Nyquist graph after immersed in NaCl solution and may provide the excellent corrosion protection.

1. INTRODUCTION

The coatings corrosion protection has been used widely in industries due to possess protection from any defects or corrosion activity.[1, 2] Corrosion occurs in metal due to the surface exposures to the environment changes and moistures such as solution. Polymers anti-corrosion protection have been used to avoid corrosion activity from penetrate to the coated materials. This study using acrylate as polymer materials to coat surface of mild steel.[3] Acrylate provides excellent coatings protection for home appliances, aircraft, marine instrument, ships, oil planter and others metal materials avoid from corrosion activity.[4–6] In this research, mild steel substrate was used as coated materials for thin films of acrylate. Carbon nanotubes discovered by Iijima in 1991 which has invented carbon nanotubes (CNTs) using arc-discharge method in powder form.[7–11] CNTs possess versatile nanofillers for blend with polymer-based such as acrylate due to tremendous properties in mechanical, electrical, thermal and structure.[12, 13]

Acrylate:carbon nanotubes (A:CNTs) nanocomposite thin film used for coating protection on coated mild steel by provides coating barrier between the metal coated and exposure medium such as sodium chloride solution used in this characterisation. Furthermore, Sol–gel technique was prepared of A:CNTs nanocomposite thin film provide a cost effective and easy way to incorporating the polymers composite and nanomaterials in order to obtain well dispersion and homogenously distributed.[4, 14]

Electrochemical impedance spectrometer (EIS) has used for evaluation corrosion performance on coating metal materials that exposure to the aqueous solution and non-destructive testing for corrosion of the coating protection.[15] In this present work, were prepared A:CNTs nanocomposite thin film by doped with varies amount of weight percentages that increment of 0.2 w/v% of CNTs into acrylate such as 0.2 w/v%, 0.4 w/v%, 0.6 w/v%, 0.8 w/v% and 1.0 w/v% to determine the coating impedance of the A:CNTs nanocomposite thin film for corrosion protection.

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*Author to whom correspondence should be addressed.

A Hybrid K-Means Metaheuristic Algorithm to Solve a Class of Vehicle Routing Problems

L. Korayem, M. Khorsid, and S. S. Kassem*

*Operations Research and Decision Support Department, Faculty of Computers and Information,
Cairo University, Giza, Egypt*

In the capacitated vehicle routing problem, a fleet of homogeneous vehicles is used to fulfill customers' demands for a single commodity. The objective is to minimize the total distance travelled by all vehicles, while satisfying constraints such as capacity constraints and logical flow constraints. The cluster-first route-second method is a two-phase heuristic used to solve the capacitated vehicle routing problem. The first phase consists of grouping customers into a number of feasible clusters, whereas the second phase consists of determining the best route to visit customers within each cluster, which amounts this phase into solving a traveling salesman problem. In the current research, a novel hybrid K-means metaheuristic, based on the recently bio-inspired grey wolf optimizer, is developed and used to cluster customers in the clustering phase. Our proposed algorithm includes three main contributions: first, the grey wolf optimizer is hybridized with the K-means clustering algorithm. Second, a capacity constraint is incorporated into the aforementioned algorithm to derive a capacitated version of the algorithm. Finally, three cluster assignment heuristics are employed to assign customers to clusters. The resulting three variants of the algorithm are tested on a number of benchmark problems. Results obtained were promising.

1. INTRODUCTION

The vehicle routing problem (VRP) is one of the most studied combinatorial optimization problems.[1] The Capacitated Vehicle Routing Problem (CVRP), one of the variants of the VRP, requires determining the optimal routes used by a fleet of homogeneous vehicles to satisfy the demands of a number of spatially separated customers. The objective is to minimize the cost represented by either the total distance travelled or the total travelling time of all vehicles. Several methods for solving CVRP have been reported in the literature varying between exact methods, heuristics and metaheuristics. For a detailed review of CVRP solution methods, interested readers are referred to Ref. [2]. Cluster-first route-second method is a two-phase heuristic used to solve CVRP, where clustering represents the core step.[3] In the first phase, customers are grouped into feasible clusters, each assigned to a vehicle. In the second phase, efficient routes are established for each vehicle, to determine the sequence of customers.

Grey Wolf Optimizer (GWO) is a new metaheuristic, introduced in 2014.[4] It mimics the leadership hierarchy, as well as the hunting mechanism observed in grey wolves. The GWO algorithm starts by a population of randomly generated wolves representing solutions. The optimum solution (prey position) is estimated through an iterative process in which the three best search agents: alpha, beta and delta are used to update the rest of the population's location. In GWO, tracking the prey represents the exploration phase while attacking it represents the exploitation phase. Experimental results verified the exploitation and exploration abilities of GWO as well as a good balance between them. Several areas of application using GWO have been recently reported in the literature.[5–7]

The K-means clustering algorithm is one of the widely used traditional partitioning approaches. In spite of being simple and easy to implement, it suffers from the possibility of falling into local minima. The merits of combining bio-inspired algorithms to K-means, to overcome the aforementioned drawback, have been shown in Ref. [8].

In the current work, we integrate the GWO algorithm with the K-means clustering algorithm producing the K-GWO hybrid clustering algorithm. The K-GWO algorithm is further enhanced and used in the clustering phase of the cluster-first route-second technique to solve CVRP. To the best of our knowledge, this is the first time to employ such integration for solving CVRP.

2. PROBLEM DEFINITION

The CVRP studied in this work considers the following assumptions: departing from a central non-capacitated depot, a single

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*Author to whom correspondence should be addressed.