LMS2023

Proceedings of International Symposium on Life Mechatronics 2023

Phnom Penh, Cambodia

March 05-08, 2023.

Organizers

Committee of Life Mechatronics Symposium (LMS) and Perceptual Information on C-branch (CPI) in the institute of electrical engineers of Japan (IEEJ)

Co-organizers

Institute of Technology of Cambodia (ITC) / JICA LBE project

Supporter(s)

Hokushin CO., LTD. / Kaeru Keisoku Co., Ltd.

Message from the General and Program Chairs

International Symposium on Life Mechatronics 2023 in Phnom Penh (LMS 2023) has been host by C-branch (CPI) in the institute of electrical engineers of Japan (IEEJ) at Institute of Technology of Cambodia, Phnom Penh, Cambodia in association with Research and Innovation Center (RIC-ITC). This event aims to promote international and cultural exchange through research and to contribute to building friendship between the ITC and Japanese researchers and students. During the symposium, various research frameworks will be shared, and the results of research activities currently being carried out by the LMS, and ITC LBE teams will be reported in order to promote research collaboration and educational development among the participants.

The Symposium is held over two days, 6-7 March 2023 both online and face to face hosted by host by C-branch (CPI) in the institute of electrical engineers of Japan (IEEJ) at Institute of Technology of Cambodia, Phnom Penh. We received 24 submissions altogether. All submitted papers were accepted and we selected 3 papers as Special talk. We invited 5 papers as Invited Talk. An oral presentation and a poster presentation were canceled. Total 27 presentations including 23 oral presentations and 4 poster presentations, and additionally 1 demonstrations were performed in this symposium.

We sincerely thank the C-branch (CPI) in the institute of electrical engineers of Japan (IEEJ) members, presenters, all committee members, faculty members and the students that contributed to this LMS Symposium.

General Chair
Chrin PHOK (Institute of Technology of Cambodia)

Organizing & Program Committee

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Jun-ichi YAMAGUCHI	(Kagawa Univ.)
Chiho MIYAKE	(JICA Project for Strengthening Engineering Education and Research for Industrial Development in Cambodia; Laboratory-Based Education Project)

LMS2023 Overall Program

Day1 (March 06, 2023)

08:30-09:00	Registration
09:00-09:30	Opening Ceremony
09:30-09:45	Coffee break
09:45-10:00	Special Talk 1: YAGI Tohru, Tokyo Institute of Technology
10:00-10:15	Special Talk 2: AOKI Hirooki, Chitose Institute of Science and Technology
10:15-10:30	Special Talk 3: MORIYAMA Tsuyoshi, Tokyo Polytechnic University
10:30-10:45	Invited Talk 1: CHEAB Sovuthy, Universiti Teknologi PETRONAS (online)
10:45-11:00	Short break
11:00-12:00	Student info session
12:00-15:00	Luncheon session (posters and demos) / Lab tour
15:00-15:15	Invited Talk 2: SHIMAZAKI Kohei, Hiroshima University (online)
15:15-16:00	Oral Session 1
16:00-16:30	Coffee break
16:30-18:00	Oral Session 2

■ Day2 (March 07, 2023)

08:30-09:00	Registration
09:00-09:15	Invited Talk 3: LO Chay
09:15-09:30	Invited Talk 4: Hin Lyhour
09:30-10:15	Oral Session 3
10:15-10:30	Coffee break
10:30-11:30	Oral Session 4
11:30-11:45	Invited Talk 5:
11:45-11:50	Closing remark Dr. CHRIN Phok / Prof. FUJIGAKI Motoharu
11:50-13:00	Lunch Break
13:00-16:00	Lab tour at Royal University of Agriculture(RUA)
16:00-17:30	Students team building session: Paper art (origami) competition

■ Day3 (March 08, 2023)

09:00-10:00	Discussion topic 1: Activity plan in 2023 onwards
10:00-11:00	Discussion topic 2: Direction of international conference
11:00-12:00	Discussion topic 3: How to enhance student exchange

LMS2023 Detailed Presentation Schedule

Day1 (March 06, 2023)

- Opening Ceremony (09:00-09:30)

	Opening remark by Deputy Director of ITC - Dr. BUN Kim Ngun
	Welcome Speech by Chairperson - Dr. CHRIN Phok
	Introduction of the symposium - Prof. FUJIGAKI Motoharu
	Research activities at ITC - Dr. Or Chanmoly

- Special Talk 1 (09:45-10:00): **Chair** Rothna Pec

	Laboratory-Based Education (LBE): An effective pedagogy that enhances academic achievement and strengthens collaboration among faculty, students, and alumni. - YAGI Tohru, Tokyo Institute of Technology

- Special Talk 2 (09:45-10:00): **Chair** Rothna Pec

	Practicing STEAM Education through Media Art Production and Exhibition Planning and Construction - AOKI Hirooki, Chitose Institute of Science and Technology

- Special Talk 3 (10:15-10:30): **Chair** Rothna Pec

	Blind safety inspection of road illumination using acoustic analysis of vibration sensors - MORIYAMA Tsuyoshi, Tokyo Polytechnic University

- Invited Talk 1 (10:30-10:45): **Chair** Rothna Pec

	Challenges in RF Lumped Element Filter Design - CHEAB Sovuthy, Universiti Teknologi PETRONAS

- Poster Session (12:00-15:00): **Chair** OHKI Hidehiro

P1	Plagiarism Detection System for Khmer Language - HUON SOPHY, ITC
P2	Masked Language Modeling for Khmer Palm Leaf Manuscript - Sothy SEK, ITC

P3	Ancient Manuscript Digitization and Indexation - Nom Vannkinh, ITC
P4	Text-Image Reconstruction and Reparation for Khmer Historical Documents - Pork Chanchen, ITC
P5	Optimization of Lab In-Verssel Throught C:N Ratio Varation of Composting Process And Quality - Vichhey NALL, ITC
D1	Prototype of a Simple Spectrometer Using Camera and Image Analysis Software - ZHU Siyan, HIBINO Shunsuke, University of Fukui

- Invited Talk 2 (15:00-15:15): **Chair** Dona Valy

	A honeybee camera that captures visiting flowers - SHIMAZAKI Kohei, Hiroshima University

- Oral Session 1 (15:15-16:00): **Chair** Dona Valy

OS1-1	ECG Data Collection using Google Sheet and Network CodingH.E. Dr. PO Kimtho - NGETH Rithea, ITC
OS1-2	Efforts to Property Evaluation of Vegetable Leaf in Hydroponic Cultivation Using Optical Sensing Technique - HIBINO Shunsuke, University of Fukui
OS1-3	Conceptual imitation to create and writing to think - OHKI Hidehiro, Oita University

- Oral Session 2 (16:30-18:00): **Chair** MORIYAMA Tsuyoshi

OS2-1	Video-rate quantitative phase analysis by a differential interference contrast (DIC) microscope using a polarization camera - OTANI Yukitoshi, Utsunomiya University
OS2-2	Development of Lab-Scale Composter for Mushroom Substrate Residual - OEUN Sothea, ITC
OS2-3	Optimal Placement of Electric Vehicle Charging Stations using Mixed-Integer Linear programming: A Case Study in Cambodia - BUNTHEOUN Sophanarith, ITC
OS2-4	Prototype of a Simple Spectrometer Using Camera and Image Analysis Software - ZHU Siyan, University of Fukui
OS2-5	The 10HS, MEC10, and MS10 Soil Moisture Sensor Calibration - BUNRONG Proeung, ITC
OS2-6	The Mobile Application of Smart Irrigation Scheduling for Rice Framing in Cambodia - KHUN Dararith, ITC

Day2 (March 07, 2023)

- Invited Talk 3 (09:00-09:15): **Chair** Chrin Phok

	Drinking water and health benefits - LO Chay, Sahakreas VEG

- Invited Talk 4 (09:15-09:30): **Chair** Chrin Phok

	Assessment of Biogas Production Potential from Commercial Pig Farms and Available Biogas Technology in Cambodia - Hin Lyhour, RUA

- Oral Session 3 (09:30-10:15): **Chair** Chrin Phok

OS3-1	Testing a single ring infiltrometer for Beerkan infiltration experiments - THA Sophanith, ITC
OS3-2	Assessing irrigation water balance for rice production in Cambodia - CHHEANG Chantria, ITC
OS3-3	Estimation of Canopy cover for rice using smartphone photography - PHOL Mengheak, ITC

- Oral Session 4 (10:30-11:30): **Chair** Ty Boreborey

OS4-1	Prediction of soil organic carbon stock using visible and near infrared reflectance spectroscopy (VNIRS) - LY Nachy, ITC
OS4-2	Image Processing for Rice Coverage Estimation Using Different Methods - YAN Sathea, ITC
OS4-3	Do biochar and cow manure compost affect the field capacity of different soil types? - SOT Channtola, ITC
OS4-4	Non-Contact Displacement Distribution Measurement Using Optical Sensing and Image Analysis - FUJIGAKI Motoharu, University of Fukui

- Invited Talk 5 (11:30-11:45): **Chair** Ty Boreborey

	Climate change: cross-cutting challenge for sustainable development - HAK Danet, ITC

Full paper review

All submitted manuscripts as full paper were reviewed by two reviewers. The following two papers were revised version after reviewing.

Development of Lab-Scale Composter for Mushroom Substrate Residual
Sothea Oeun, Sokheng Meng, Chanreng Sey Nhim, Sopheaktra Chhorn, Sovichea Tep, Chanthan Hel, Pinnara Ket

Optimal Placement of Electric Vehicle Charging Stations using Mixed-Integer Linear programming: A Case Study in Cambodia
Buntheoun Sophanarith, Kim Bunthern, And Vai Vannak

Special Talk 1

Laboratory-Based Education (LBE): An effective pedagogy that enhances academic achievement and strengthens collaboration among faculty, students, and alumni.

Tohru Yagi*

* *Tokyo Institute of Technology*

Abstract

LBE is a laboratory-based education system found in several countries including Japan and the U.S. In LBE, laboratory alumni have strong ties and academic achievements are passed on from generation to generation. In this workshop, I will summarize the characteristics of LBEs and discuss their advantages by introducing examples of LBEs in Japan and the United States.

Special Talk 2

Practicing STEAM Education through Media Art Production and Exhibition Planning and Construction

Hirooki Aoki*

* *Chitose Institute of Science and Technology*

Abstract

STEAM education, which adds ART to STEM education, is attracting attention. Media art is actively created with the aim of fusing art and technology, but in the first place, art and technology have the same etymology. Focusing on the relationship between art and technology, we created media art works in collaboration with artists. In addition, by planning and setting up an exhibition to display those works, a new STEAM education practice was attempted.

Blind safety inspection of road illumination using acoustic analysis of vibration sensors

Tsuyoshi MORIYAMA[1*]

[1] *Dept. of Engineering, Tokyo Polytechnic University*

5-45-1 Iiyama-minami, Atsugi, Kanagawa 243-0297 Japan.
**Corresponding author: moriyama@t-kougei.ac.jp*

Abstract

A method of detecting loosening of bolts of road illumination using vibration sensors and acoustic signal analyses is proposed. Experimental results on data collection and statistical analysis demonstrate that mel-frequency cepstrum coefficients (MFCC) reflect significant changes due to bolt loosening. Moreover, principal component analysis on MFCC succeeded to reduce the dimensionality for achieving efficient discrimination of bolt loosening without opening road illumination for inspection. This presentation also introduces a feasible result of speech analysis that uses MFCC, which realizes an example of connecting completely different interdisciplinary problems each other by a common analysis method of MFCC.

Keywords: *Road Illumination, Noninvasive inspection, Mel-frequency cepstrum coefficients, Vibration sensors, Pattern analysis*

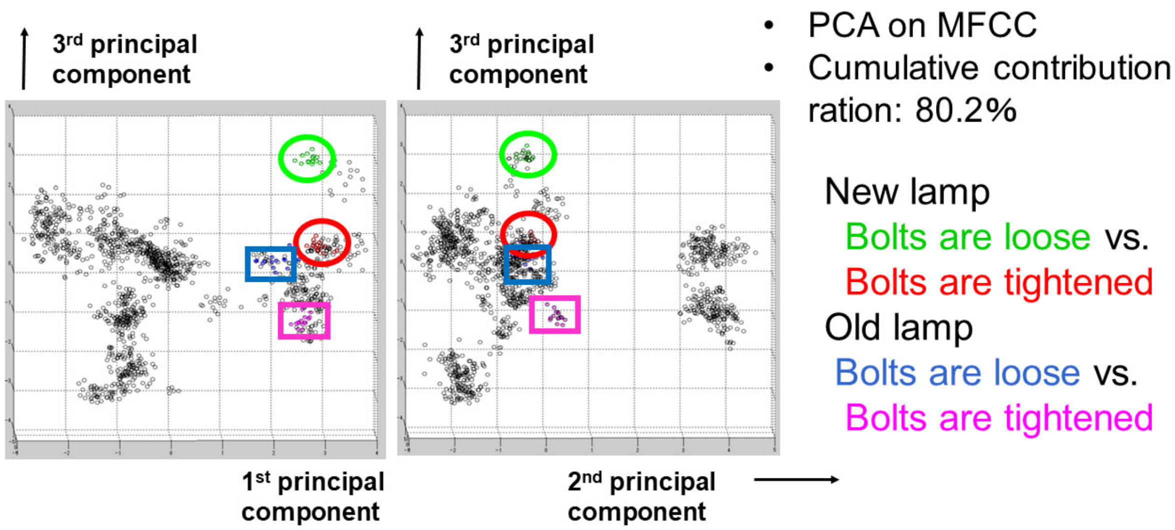


Fig. 1 MFCCs reflect bolt loosening and the 3rd principal component is useful in inspection.

Invited Talk 1

Challenges in RF Lumped Element Filter Design

CHEAB Sovuthy*

* *Universiti Teknologi PETRONAS*

Invited Talk 2

A honeybee camera that captures visiting flowers

Kohei Shimasaki*, Junhao Li, Hironori Yoshida, Idaku Ishii, Mari Ogihara, Mikio Yoshiyama

* *University of Fukui*

Abstract

Honeybees make a significant contribution to agriculture by pollinating various crops. This research achieves visualization of honeybees visiting flowers by using high frame rate (HFR) images and implementing pixel-level vibration source localization based on the short-time Fourier transform to inspect the periodic brightness changes at hundreds of hertz utilizing the characteristics of bees hovering when visiting flowers.

Invited Talk 3

Drinking water and health benefits

LO Chay *

* *Sahakreas VEG*

Invited Talk 4

Assessment of Biogas Production Potential From Commercial Pig Farms and Available Biogas Technology in Cambodia

Hin Lyhour*

* *Royal University of Agriculture (RUA)*

Invited Talk 5

Sustainable Development Goals in the aspect of Agriculture and Technology

HAK Danet*

* *Institute of Technology of Cambodia*

Uploading Data to Google Sheet using Network Coding

NGETH Rithea[1*], IEN Hengsokchamroeun[2], SORN Sopheak[3], CHHEANG Taymeng[3], ROM Pouseang[3], CHHORNG Sambath[3]

[1] *Department of Telecommunications and Networks Engineering, Institute of Technology of Cambodia,*

[2] *Graduated student, Undergraduate program of Department of Telecommunications and Networks Engineering, Institute of Technology of Cambodia*

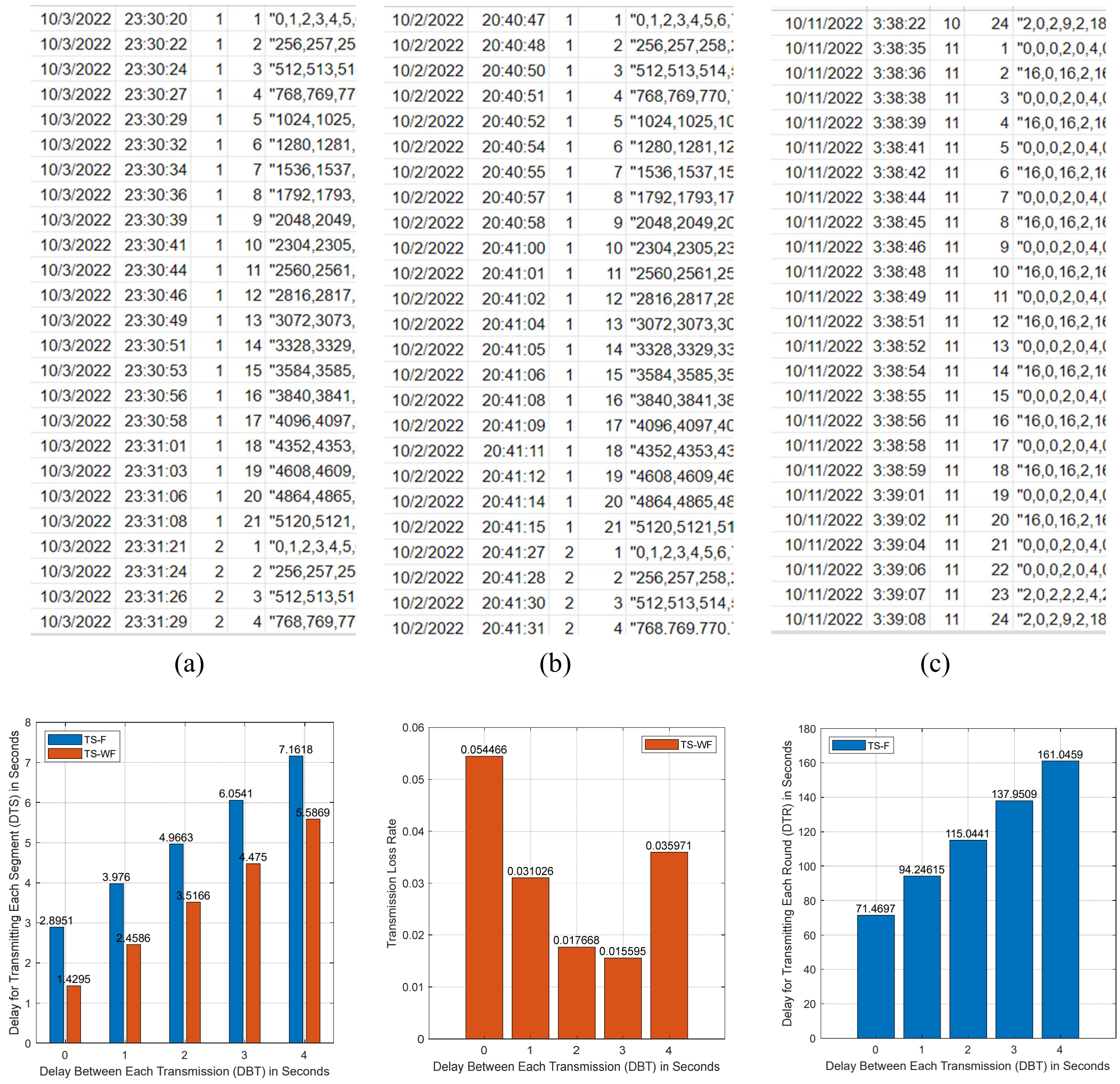
[3] *Undergraduate students, Department of Telecommunications and Networks Engineering, Institute of Technology of Cambodia,*

Russian Federation Blvd., P.O. Box 86, 12156 Phnom Penh, Cambodia.
**Corresponding author: ngethrithea@itc.edu.kh*

Abstract

This research considers the sensor data collection using Google Sheets with microcontroller ESP8266. Two data transmission approaches are discussed in this work: (1) using feedback for each segment of data transmission, called transmission scheme with feedback (TS-F); (2) using linear network coding (LNC) for data transmission without needing feedback, called transmission scheme using LNC (TS-LNC). In data uploading to Google Sheet, there is a need of adding delay between each transmission (DBT). DBT affects the transmission loss rate and the duration to complete whole data transmission of each round. In experiment, there are 21 segments of data for each round and the data is the numeric value starting from 0 to 5375. From the experimental data for TS-F, as they should be, there is no transmission loss, and the duration of one transmission is lowest while setting DBT to zero as shown in Fig. 1(d). The example of received data on Google Sheet using TS-F for the case that DBT is equal to zero is shown in Fig. 1(a). In order to employ TS-LNC, the empirical transmission loss rate is needed beforehand to estimate the number of coded segments needed for the redundancy transmission. Thus, the transmission scheme without feedback (TS-WF) is done while LNC is not employed. The example of received data on Google Sheet using TS-WF for the case that DBT is equal to zero is shown in Fig. 1(b). From the empirical transmission loss rate, the highest loss rate happened at the case that DBT is set to zero as shown in Fig. 1(e), but this case can provide the shortest duration of the one round data transmission as shown in Fig. 1(d). From the experimental data, the latency of each segment transmission for TS-WF is around 66% in average of the latency of TS-F. It is because of waiting for feedback form Google Sheet. Therefore, according to the empirical loss rate as shown in Fig. 1(e), in this work, for TS-LNC, the microcontroller needs to transmit 3 more coded segments comparing to TS-F for each round to ensure the successful recovery of data in each round while DBT is set to be zero. LNC is done in finite field of order 32 at ESP8266. The example of received data on Google Sheet using TS-LNC for the case that DBT is equal to zero is shown in Fig. 1(c). The data is the numeric value in finite field F_{2^5} starting from 0 to 10242 with increment of 2. The data in one round can be recovered if the number of received segments (including coded segments) is higher than or equal to 21.The results showed that the duration needed to transmit one round of data transmission for TS-LNC is 48.38 seconds (including the duration for reading the sensor data), equivalent to around 67% of the duration needed for TS-F in the best case as shown in Fig. 1(f). However, the successful rate of recovering data in TS-LNC is 98.92% but not 100%, because the number of lost segments might be higher than 3 in some transmission rounds. In addition, the transmission loss rate depends also the stability of the internet connection at the time of transmission. In conclusion, TS-LNC can provide less duration for uploading whole data to Google Sheet in case the internet connection is stable. This condition might be not applicable in rural area in Cambodia. Therefore, the combination of TS-LNC and TSF will be done in order to ensure the recovery of data with short duration of data uploading.

Keywords: *Uploading data, Linear Network Coding, Google Sheet, Transmission Latency*



10/3/2022	23:30:20	1	1	"0,1,2,3,4,5,
10/3/2022	23:30:22	1	2	"256,257,25
10/3/2022	23:30:24	1	3	"512,513,51
10/3/2022	23:30:27	1	4	"768,769,77
10/3/2022	23:30:29	1	5	"1024,1025,
10/3/2022	23:30:32	1	6	"1280,1281,
10/3/2022	23:30:34	1	7	"1536,1537,
10/3/2022	23:30:36	1	8	"1792,1793,
10/3/2022	23:30:39	1	9	"2048,2049,
10/3/2022	23:30:41	1	10	"2304,2305,
10/3/2022	23:30:44	1	11	"2560,2561,
10/3/2022	23:30:46	1	12	"2816,2817,
10/3/2022	23:30:49	1	13	"3072,3073,
10/3/2022	23:30:51	1	14	"3328,3329,
10/3/2022	23:30:53	1	15	"3584,3585,
10/3/2022	23:30:56	1	16	"3840,3841,
10/3/2022	23:30:58	1	17	"4096,4097,
10/3/2022	23:31:01	1	18	"4352,4353,
10/3/2022	23:31:03	1	19	"4608,4609,
10/3/2022	23:31:06	1	20	"4864,4865,
10/3/2022	23:31:08	1	21	"5120,5121,
10/3/2022	23:31:21	2	1	"0,1,2,3,4,5,
10/3/2022	23:31:24	2	2	"256,257,25
10/3/2022	23:31:26	2	3	"512,513,51
10/3/2022	23:31:29	2	4	"768,769,77

(a)

10/2/2022	20:40:47	1	1	"0,1,2,3,4,5,6,
10/2/2022	20:40:48	1	2	"256,257,258,
10/2/2022	20:40:50	1	3	"512,513,514,
10/2/2022	20:40:51	1	4	"768,769,770,
10/2/2022	20:40:52	1	5	"1024,1025,10
10/2/2022	20:40:54	1	6	"1280,1281,12
10/2/2022	20:40:55	1	7	"1536,1537,15
10/2/2022	20:40:57	1	8	"1792,1793,17
10/2/2022	20:40:58	1	9	"2048,2049,20
10/2/2022	20:41:00	1	10	"2304,2305,23
10/2/2022	20:41:01	1	11	"2560,2561,25
10/2/2022	20:41:02	1	12	"2816,2817,28
10/2/2022	20:41:04	1	13	"3072,3073,30
10/2/2022	20:41:05	1	14	"3328,3329,33
10/2/2022	20:41:06	1	15	"3584,3585,35
10/2/2022	20:41:08	1	16	"3840,3841,38
10/2/2022	20:41:09	1	17	"4096,4097,40
10/2/2022	20:41:11	1	18	"4352,4353,43
10/2/2022	20:41:12	1	19	"4608,4609,46
10/2/2022	20:41:14	1	20	"4864,4865,48
10/2/2022	20:41:15	1	21	"5120,5121,51
10/2/2022	20:41:27	2	1	"0,1,2,3,4,5,6,
10/2/2022	20:41:28	2	2	"256,257,258,
10/2/2022	20:41:30	2	3	"512,513,514,
10/2/2022	20:41:31	2	4	"768,769,770,

(b)

10/11/2022	3:38:22	10	24	"2,0,2,9,2,18
10/11/2022	3:38:35	11	1	"0,0,0,2,0,4,
10/11/2022	3:38:36	11	2	"16,0,16,2,1
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10/11/2022	3:38:39	11	4	"16,0,16,2,1
10/11/2022	3:38:41	11	5	"0,0,0,2,0,4,
10/11/2022	3:38:42	11	6	"16,0,16,2,1
10/11/2022	3:38:44	11	7	"0,0,0,2,0,4,
10/11/2022	3:38:45	11	8	"16,0,16,2,1
10/11/2022	3:38:46	11	9	"0,0,0,2,0,4,
10/11/2022	3:38:48	11	10	"16,0,16,2,1
10/11/2022	3:38:49	11	11	"0,0,0,2,0,4,
10/11/2022	3:38:51	11	12	"16,0,16,2,1
10/11/2022	3:38:52	11	13	"0,0,0,2,0,4,
10/11/2022	3:38:54	11	14	"16,0,16,2,1
10/11/2022	3:38:55	11	15	"0,0,0,2,0,4,
10/11/2022	3:38:56	11	16	"16,0,16,2,1
10/11/2022	3:38:58	11	17	"0,0,0,2,0,4,
10/11/2022	3:38:59	11	18	"16,0,16,2,1
10/11/2022	3:39:01	11	19	"0,0,0,2,0,4,
10/11/2022	3:39:02	11	20	"16,0,16,2,1
10/11/2022	3:39:04	11	21	"0,0,0,2,0,4,
10/11/2022	3:39:06	11	22	"0,0,0,2,0,4,
10/11/2022	3:39:07	11	23	"2,0,2,2,2,4,
10/11/2022	3:39:08	11	24	"2,0,2,9,2,18

(c)

(d)

(e)

(f)

Fig. 1 Figures of results for this work

OS1-2

Efforts to Property Evaluation of Vegetable Leaf in Hydroponic Cultivation Using Optical Sensing Technique

Shunsuke Hibino*, Jiang Wei, Motoharu Fujigaki, Hirofumi Fujino

* *University of Fukui*

Abstract

We used an optical sensing technique to evaluate the properties of vegetables grown by hydroponics. The properties were evaluated from the measurement results of the vibrated leaves at a certain frequency. The displacement distribution and the frequency are measured using a laser slit and a camera with a diffraction plate.

OS1-3

Conceptual imitation to create and writing to think

Hidehiro Ohki*

* *Oita University, JAPAN*

Abstract

How do ideas come from within me? How do I develop the ideas that come to me? This is the first difficulty that new researcheres face. My current answer is to imitate the concept and write it down.

OS2-1

Video-rate quantitative phase analysis by a differential interference contrast (DIC) microscope using a polarization camera

Yukitoshi Otani*, Wataru Takano, Nathan Hagen, Masaru Matsuda

* *Center for Optical Research and Education, Utsunomiya University, 7-1-2 Yoto, Utsunomiya, Tochigi, Japan*

Abstract

A differential interference contrast (DIC) microscope is used to observe transparent samples without staining by converting phase gradients into intensity variations. We popose how to adapt DIC microscopes with a polarization camera to allow real-time quantification of the sample phase distribution.

Development of Lab-Scale Composter for Mushroom Substrate Residual

Sothea Oeun[1]*, Sokheng Meng[1], Chanreng Sey Nhim[2],

Sopheaktra Chhorn[2], Sovichea Tep[2], Chanthan Hel[2], Pinnara Ket[3]

[1]*Department of Electrical and Energy Engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, Phnom Penh, Cambodia*

[2]*Department of Telecommunication and Network Engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, Phnom Penh, Cambodia*

[3]*Faculty of Hydrology and Water Resources Engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, Phnom Penh, Cambodia*

Corresponding author: oeunsothea8800@gmail.com

Abstract: *This paper's primary goal is to examine the prototype of a smart composter machine that turns mushroom substrate residual and another organic waste into fertilizer. This compost machine is made with two settings, Automatic Mode and Manual Mode, which are intended to manage specific factors to produce compost quickly and with high quality. The machine has a number of sensors, including those that detect 02 (measure range: 0-30%), CO2 (measure range: 0-5000ppm), humidity (measure range: 0% RH-100% RH),and temperature (measure range: -40 degree Celsius to +70 degree Celsius). The users can select their own desired values for various parameters, such as temperature, humidity, and some mechanical movements of the motor, for example, the users can control the states of the mixing bar, heater, exhausted fan, and pump. All sensor data will be displayed on a touchscreen display. Structure design, hardware design, firmware design, and interface design are the four key areas that make up this research. The design of the structure is divided into two main components: the shredder section, which is used to reduce the input material's particle size, and the compost tank, which includes various functions including sensor reading, heating, moisturizing compost, etc. The main microcontroller (STM32F103C8T6), a touch screen display (Nextion Basic Series 7.0"), a heater, some electrical protective devices like circuit breakers, contactors, emergency buttons, switches, and RCBOs, as well as other devices like AC and DC motors, exhausted fans, pumping are all included in the electrical hardware design. Each part of the hardware is controlled by the firmware design. The primary programming usually handles different common communication protocols (SPI, ADC, Rs485, and UART) that are embedded in each component and gives an accurate acquisition time for the sensor through interrupt. The design of the user interface, which is the final part of the work, is necessary since the Smart Compost Bin was created with a touchscreen display. The user can control some components for the composting process through this interface and monitor the parameter in real time.*

Keywords: Fertilizer Machine , Smart Compost Bin; Automatic Compost Machine; Foot Waste Converter

1. INTRODUCTION

Food waste has become a societal problem because it occurs practically everywhere and includes many fruits and vegetables that are thrown away without being used again [1] . Specifically, after harvesting the mushrooms, the spent mushroom substrates (SMS) are no longer utilised in mushroom cultivation [2]. Some farmers learned how to make natural compost, so they utilize vegetable waste, fruit waste, and rice straws along with manure and plants like trees, leaves, and fresh grass to create compost that can be used as fertilizer for crops. This can aid in reducing food waste generated at home [3]. Although it can take weeks, months, or even years to produce, it is not guaranteed that this natural compost can be utilized as fertilizer [4].It was stated that there is very little knowledge now available on creating compost for farm use. On the other side of the farm level, the farmers continue to use subpar methods for managing the soil and the composting process. Low agricultural yields result from their adherence to traditional methods. This composting machine is able to generate compost in a short amount of time while achieving high efficiency because generating natural compost fertilizer is low tech and takes a long period before it is productive.

2. METHODOLOGY

The composting machine prototype is composed of four primary components. The first one is concentrated on the mechanic and has two crucial components: a shredder and a compost tank. Electrical system desing is the second component. This section is focused on selecting a microcontroller, BLDC motor, AC motor, and some necessary electrical parts like wire, heater, power supply for DC devices, motor driver, and sensors that can function in a hot environment around 70 degrees Celsius because the environment of the compost tank requires a hot temperature to create the best conditions for microorganisms to start decomposing [5]. The third section is firmware design, which has a crucial function in workflow management and enables all system components to operate concurrently and independently while yet delivering quick responses. The final part is interface design, which enables users of the prototype to utilize it easily and comfortably.

2.1 Structure Design

The shredder is the first component of the structure's construction, and it is used to chop up the input material to increase the surface area that may be heated. For the design of a compost tank, the dimensions of the compost machine, the volume of the tank, the mixing bar, the water tank, and locations to mount electrical parts like a Nextion display, a heater, sensors, an exhausted fan, an AC motor for the shredder, a BLDC motor for the mixing bar, and a control panel are all taken into consideration.

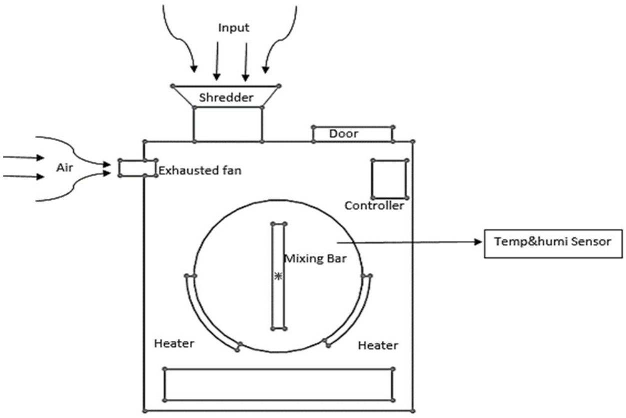

Fig 1.1. Structure of Composter Machine

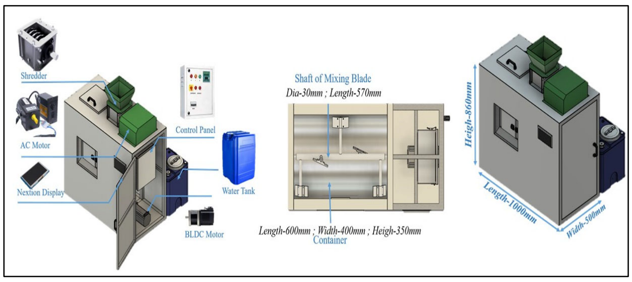

Fig 1.2. Structure of Compost Machine in Fusion 360

Table 1. Dimension of structure design

Structure Machine	L=1000mm ; W=500mm ; H=860mm
Container	L=600mm ; W=400mm ; H=350mm
Shaft of Mixing Blade	D=30mm ; L=570mm
Water Tank	Capacitor-20L ; Size-28.5x26x38.5cm

2.2 Electrical system design

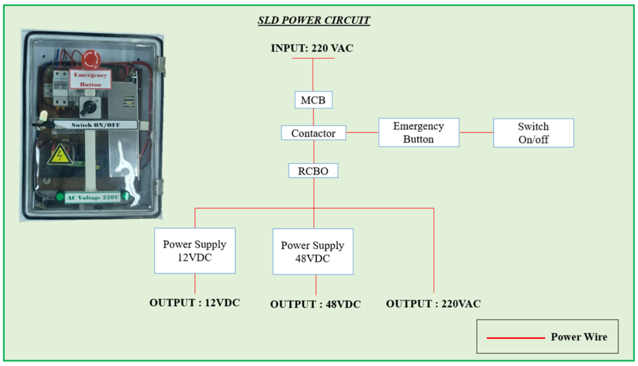

Fig 1.3. SLD of Power Circuit

The PC (power circuit) and CC (control circuit) systems of this hardware architecture are installed and isolated in two distinct panels. The system is powered by alternating current, hence this machine needs 220VAC to function. To avoid any errors and shield consumers from electrical shocks brought on by current leakage, the MCB and RCBO are chosen. In case of any accidents brought on by mechanical movement, this PC also has an emergency button for further security. To let the user know when the system is on, those two pilot lights are positioned on the panel cover's outside. Two power supply are required to operate the DC (direct current) components. For the BLDC motor driver to function, 48VDC is needed, as well as 12VDC, 5VDC, and 3.3VDC for additional dc accessories. A step-down voltage regulator provides these voltage ranges. The stm32f103c8t6 microcontroller is used in this composting machine. High performance is conducted by this type of IC at an operating frequency of 72 MHz. The voltage regulator for this STM32 development board, which draws power from a 12VDC power source, is linked to 3.3VDC. The parts are connected to an AC source such as an AC motor (attached to the shredder, operating at 220 VAC and 25 watts), a heater (capable of producing a temperature of 240 degrees Celsius), and a pumping motor (Operating Voltage 220VAC, Operating Current 0.4A). As the motor pumping, heater, and exhaust fan cannot be controlled directly by the microcontroller, they are each connected to a relay (Signal Control 5VDC, Load 220VAC, Current Rating 10A), which controls their on/off states in response to a signal from the controller. This machine has five separate sensors: an oxygen sensor, a carbon dioxide sensor, a temperature sensor (PT100), a temperature and humidity sensor, and an EC sensor (temperature and moisture & EC sensor). These sensors are operated in the following voltage ranges: 12, 12, 5, 12, and 12, respectively. The regulator's 5V output is connected to the Nextion Display, which communicates with the aforementioned microcontroller using the UART protocol. The 48VDC power supply is only utilized in conjunction with the BLD-750 motor driver to control BLDC motors. The oxygen and carbon dioxide sensors generate a current signal, thus we need additional resistors to convert that signal to an analog signal. Drivers are needed for some sensors in order to translate data for the microcontroller, and such drivers communicate using the UART and SPI protocols. The motor driver for the DC motor used to rotate the mixing bar received a signal from the controller to control the BLDC motor, which was linked to the mixing bar.

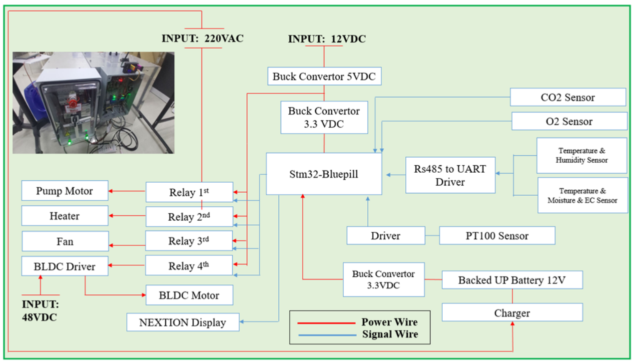

Fig 1.4. SLD of Control Circuit

2.3 Firmware design

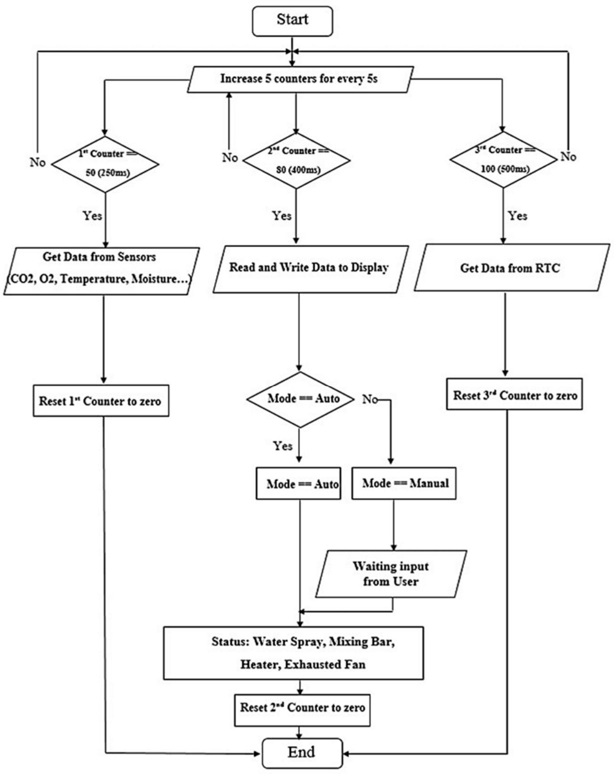

Fig 1.5. Algorithm of firmware design

Counters are established in firmware design to take those numbers and do the duties necessary to ensure that all devices operate according to the schedule. Two crucial tasks were controlled by firmware. Getting data from sensors is the first task. When the first counter reaches 50 counts equals 250 ms, this task is initiated. That first counter will be reset to zero whenever the microcontroller receives data. The second step is to write and read data from the Nextion touchscreen display. It will determine if it is for automated mode or manual mode. The system will start to control some electrical components, such as the states of the motor connected to the mixing bar, the heater that provides the hot temperature for the compost tank, the water spray that provides the compost with humidity, and the exhausted fan that regulates the air in the tank, once the user inputs the parameters. If the microcontroller detects any values from the nextion display, it will be in the manual mode. The second counter will be reset to 0 and begin counting once this condition is complete. The third counter is just used to obtain the current time using the STM32-Bluepill's inbuilt RTC. In order to operate the compost machine, this code is created to take data from sensors and write data to actuators and it is performed as a loop.

2.4 Interface design

Fig 1.6 User interface design on display

This prototype uses a touchscreen display for managing several types of equipment and monitoring all the parameters, thus it has to have a user interface designed for it. It was created with the four-page interface that is seen in the Khmer version . The first page serves as the startup page. It flashes to the second page after displaying the ITC name and logo for a brief period of time. As several criteria and the steps involved in manufacturing compost were shown on this page, it serves as the main page or home page. As seen in figure 1.6, the bottom of this page includes three buttons: a Home button, a Setting button, and an About button. The Setting page will open up whenever the user selects the Setting button. A user interface's third page is the settings page. This page allows users to choose whether composting should be done manually or automatically. The user may also change the display's brightness on this page. With the manual option, the user may change the motor states, the time it takes to make compost, the pump motor's state, and heater. The About page is the last page of the user interface. The goal of the project and the contact information for the creator are displayed on the "about" page. Hence, if a consumer has an issue with the composting device, they may get in touch with the creator.

3. RESULTS

The compost machine is able to complete its task such as heating control, controlling air in the compost tank, mixing the compost, spraying for compost moisture, but during the experiment, some problems are found. Some sensors can't read and update its values due to sensors' placement.

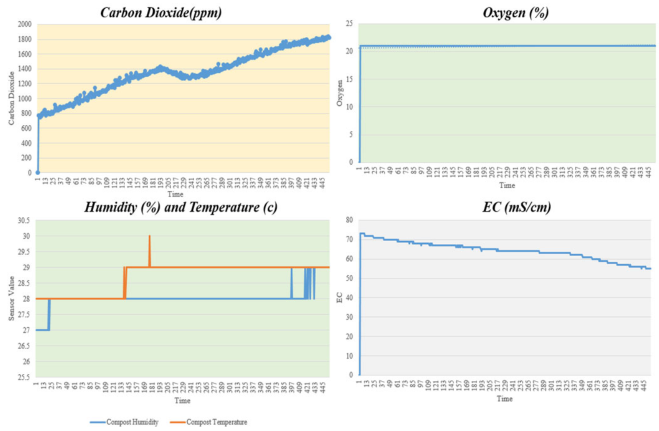

Fig 1.7 The values from sensors

To sum up, this prototype has four main purposes. The initial point can optimize and stability parameters of the composting process to obtain high-quality compost. Secondly, providing low-cost compost for the farmer to use in agriculture. The third purpose is for helping reduce spend mushrooms from farm to environment. The last one is for sharing knowledge and finding new technologies for farmers.

4. CONCLUSIONS

One of the primary parts, the heater, produces heat for the compost, enabling the organic waste composting machine to speed up the composting process by gradually raising the temperature of the compost. The heater needs a large current to function, thus the relay must be carefully chosen. The protective devices must be chosen since the machine must run continually, to protect the operator from electric shock and to keep components from overloading as a result of some failures. Also, the location of the sensor is crucial since if it is put incorrectly, it won't be able to produce an accurate reading or maybe damaged.

ACKNOWLEDGMENT

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Optimal Placement of Electric Vehicle Charging Stations using Mixed-Integer Linear programming: A Case Study in Cambodia

BUNTHEOUN Sophanarith*, KIM Bunthern, and VAI Vannak
Institute of Technology of Cambodia/ Department of Electrical and Energy Engineering, Phnom Penh, Cambodia

Email: sophanarithbuntheoun@gmail.com ; kimbunthern@itc.edu.kh ; vannak.vai@itc.edu.kh

***Abstract* - Nowadays, due to the increase in prices and the environmental pollution of fossil fuels, individuals and governments are tending towards the concept of electric vehicles. Therefore, the popularity of electric vehicles is increasing. With the development of technologies, the number of electric vehicles raised the required quantity of charging stations. This study introduces an optimization model that deals with the optimal placement of charging stations in terms of investment and ease of use. First, the potential locations for charging stations are determined. With the help of the historical route of electric vehicles, a MILP problem is solved to find optimal placements. In this study, Cambodia is examined as a case study in a simplistic matter. The model can achieve the optimal solution regardless of the size of the data.**

***Index Terms* - Electric Vehicle, Charging Station Placement, Optimization.**

I. Introduction

All-electric vehicles (commonly referred to as EVs or BEVs) don't use gasoline, and instead have a large battery that powers one or more electric motors. Currently, all-electric vehicles have a driving range of 80 to more than 300 miles, with ranges increasing as new models are introduced. In addition to driving past the gas station, all-electric vehicles don't require much maintenance (such as oil changes, smog checks, spark plug changes and replacing a catalytic converter or various other parts that wear out and break down) compared to gas cars [1]. There exist different types of vehicles that run with electricity, some of them are completely electric and they are known as all-electric vehicles (also called battery-electric vehicles (BEVs) and some are partially electric, including hybrid electric vehicles (HEVs) and plug-in hybrid electric vehicles (PHEV) [2]. The running cost of an electric vehicle is much lower than an equivalent petrol or diesel vehicle. Electric vehicles use electricity to charge their batteries instead of using fossil fuels like petrol or diesel. Electric vehicles are more efficient, and that combined with the electricity cost means that charging an electric vehicle is cheaper than filling petrol or diesel for your travel requirements. Using renewable energy sources can make the use of electric vehicles more eco-friendly. The electricity cost can be reduced further if charging is done with the help of renewable energy sources installed at home, such as solar panels [3]. The disadvantages of an Electric Car Although the evidence of the positives has become very clear, there are also some downsides that each individual needs to consider before they decide to make an electric car their next big investment. These reasons are: 1) Recharge Points: Electric fuelling stations are still in the development stages. Not a lot of places you go to on a daily basis will have electric fuelling stations for your vehicle, meaning that if you're on a long trip or decide to visit family in a rural or suburban area and run out of charge, it may be harder to find a charging station. You may be stuck where you are.However, until charging stations are more widespread, be sure to have a charging station maps where you live and where you frequently go so that you'll be able to charge your new EV when you need to, 2) The Initial Investment is Steep: As EVs are very new, you may be surprised when you take a look at the sticker price for EVs. Even the more affordable brands can be around $30,000 to $40,000.If you're looking for a luxury option, you may be paying $80,000 or even more. Though technology is advancing and the price to produce electric cars continues to drop, you still have to pay $10,000 to $50,000 more for an EV than for a gas-powered car, 3) Electricity isn't Free: Electric cars can also be a hassle on your energy bill if you're not considering the options carefully. If you haven't done your research into the electric car you want to purchase, then you may be making an unwise investment, 4) Short Driving Range and Speed: Electric cars are limited by range and speed. Most of these cars have a range of about 50-100 miles and need to be recharged again. You just can't use them for long journeys as of now, although it is expected to improve in the future, 5) Longer Recharge Time: While it takes a couple of minutes to fuel your gasoline-powered car, an electric car takes about 4-6 hours and sometimes even a day to get fully charged. Therefore, you need dedicated power stations as the time taken to recharge them is quite long. Thus, the time investment and necessary planning do put some people off.There are some kits that can cut the charging time down. But again, that is going to be an additional investment. So consider that, too, 6) Silence as a Disadvantage: Silence can be a bit disadvantage as people like to hear the noise if they are coming from behind them. An electric car is, however, silent and can lead to accidents in some cases, 7) Normally 2 Seaters: Most of the electric cars available today are small and 2 seated only. They are not meant for the entire family, and a third person can make a journey for the other two passengers a bit uncomfortable, 8) Battery Replacement: Depending on the type and usage of battery, batteries of almost all electric cars are required to be changed every 3-10 years, 9) Not Suitable for Cities, Facing Shortage of Power: As electric cars need the power to charge up, the cities that already facing acute power shortages are not suitable for electric cars. The consumption of more power would hamper their daily power needs, 10) Lower Amount of Choices: The market today for electric cars is expanding, with no signs of slowing down. However, the truth is that there are fewer options to customize and choose the aesthetics of your EV. At the same time, the vast amount of customization is available with traditional cars. This is likely to change over time, but for many people, it is going to be a disadvantage, 11) Minimal Amount of Pollution: Electric vehicles are also not 100% emission-free; they cause a little amount of pollution indirectly. The batteries and electricity needed for charging are not necessarily generated from renewable energy sources, 12) Some Governments Do Not Provide Money Saving Initiatives to Encourage You to Buy an Electric Car: Just because there is a variety of factors doesn't mean they have to be overwhelming. Doing a fair bit of research into different models, and maybe even hybrids will help you make an accurate decision moving forward. However, no matter how you look at it, an electric car can save our precious environment [4]. Based on the power and the range of voltages that are supported by EV chargers, they are classified into three levels A) lower than 3.7 kW are Level 1 chargers, B) between 3.7 and 22 kW are Level 2 chargers, and C) higher than 22 kW are Level 3 chargers[5]. Charging stations in Cambodia have four provinces phnom penh, Sihanoukville, Battambang province, and Siem Reap province [6].

Cambodia's government's strategic plan is to achieve zero carbon rates by 2050. ensure that the distance of the electric vehicles from the charging stations is at a minimum distance at any time and aimed to keep the cost of installation of the charging station at the lowest level.

This paper studies the optimal placement of charge stations in Cambodia, to minimize investment costs, to minimize the distance to the stations / minimize charging time, Analysis of the balance between investment cost and distance of the EV to the charging station. The scope and limitations of this study are Existing national roads, Existing petrol stations for the potential EV charging station, ignoring traffic, and all level-3 charging stations. We also expected output: 1) Find a solution of Optimal placement for a selected number of stations, 2) Can provide analysis of the balance of cost and charging time based on the data of specific scenarios, 3) Provide a general optimal solution to data based on the actual scenario and expected outcome: help to provide consultation for investment in EVs.

II. METHODOLOGY

A. *Flowchart of Procedure*

In this paper, the Optimal Placement of Electric Vehicle Charging Stations using Mixed-Integer Linear programming while satisfying the constraints is performed. The eight following steps will be addressed in this research; 1) Set number of vehicles, 2) Day is divided into two equal time zones, 3) Set possible charging locations, 4) we got Distances of the vehicles, 5) Objective Function, 6) Constraints, 7) Developed MATLAB (MILP) and 8) we got Results Optimal stations. Fig.1 shows the flowchart for the various steps of the proposed algorithm.

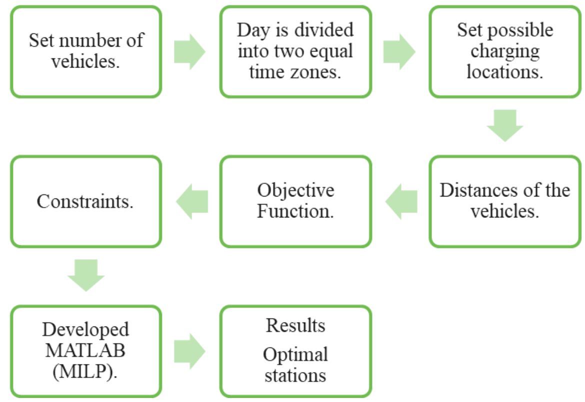

Fig. 1 Flowchart of Procedure

B. *Data input*

The proposed data input as Fig. 2 and Fig. 3 below:

1) Customs five numbers of the vehicle.
2) A single day is divided into two equal time zones: morning and evening.
3) Ten possible charging locations:
    1) Phnom Penh (PP)
    2) Svay Rieng province (SVR)
    3) Sihanoukville (SHV)
    4) Koh Kong province (KK)
    5) Battambang province (BTB)
    6) Siem Reap province (SR)
    7) Preah Vihear province (PVH)
    8) Steung Treng province (STR)
    9) Ratanakiri province (RTK)
    10) Mondulkiri province (MDK)
4) Distances of the vehicles to each location.

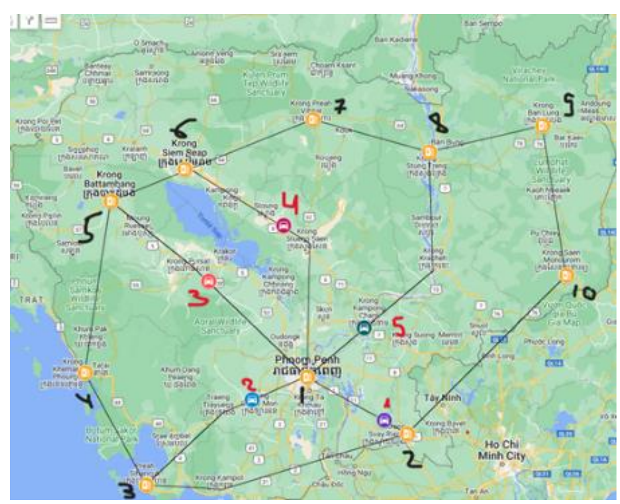

Fig. 2 Morning Location of vehicles

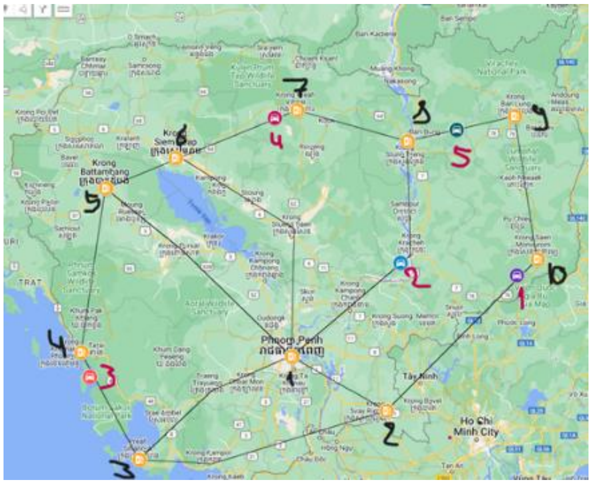

Fig. 3 Evening Location of vehicles

C. Indices and Set

These are indicated by the index:

1) $v = vehicle$.
2) t = time.
3) j = candidate locations.
4) $x = binary$ (0,1) vehicle being present in time t at the station j.
5) $yj = binary$ (0,1) decision variable that is 1 if a charging station is opened.
6) Qj = the number of vehicles that can charge there simultaneously.
7) P = charging stations chosen from a set of candidate locations j.

D. Objective function and Constraints [7]

$$min \quad \sum_{(v,t,j)} d_{v,t,j} x_{v,t,j} \qquad (1)$$

$$s.t. \quad \sum_{(v,t,j)} x_{v,t,j} = 1 \qquad \forall v \in V \qquad (2)$$

$$x_{v,t,j} \leq y_j \qquad \forall (v,t,j) \qquad (3)$$

$$\sum_{(v,t,j)} x_{v,t,j} \leq Q_j y_j \qquad \forall j \in J \qquad (4)$$

$$\sum_{(j\epsilon J)} y_j = P \qquad (5)$$

(1) The objective is to minimize the total distance traveled by all vehicles to access the selected charging stations. Constraint (2) ensures that each vehicle is charged by selecting one charging option. Constraint (3) is a feasible cut introduced for computational purposes—it says vehicle v can charge at location j only if a charging station is opened there. Constraint (4) ensures that the number of vehicles assigned to a charging station at location j is not beyond the capacity of that location in any period. Constraint 5 makes sure that exactly P charging stations are opened.

E. Developed MATLAB (MILP)

This is an algorithms of procedure developed MATLAB, the Optimal Placement of Electric Vehicle Charging Stations using Mixed-Integer Linear programming that we follow from Flowchart of Procedure and then we develop on random sample distance of vehicles and average results is shown in Fig.4.

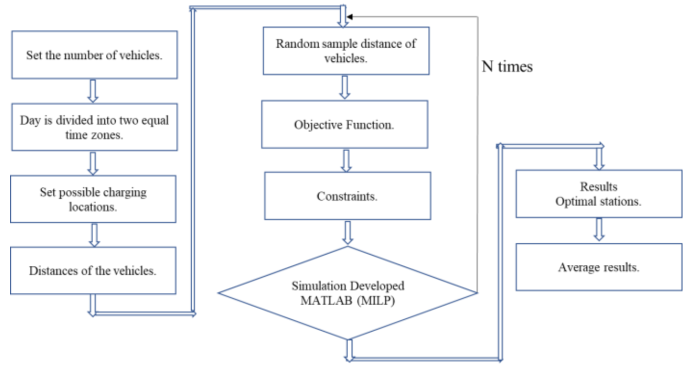

Fig. 4 Flowchart of Procedure developed MATLAB

F. Case Study

A simple case study is adapted to clearly represent the effectiveness of the model and to provide a test trial for the interested audience. A simplistic map of Cambodia is shown in Fig. 2-3 with ten possible charging stations. These locations are in alphabetical order; Phnom Penh city, Svay Rieng province, Sihanoukville, Koh Kong province, Battambang province, Siem Reap province, Preah Vihear province, Stung Treng province, Ratanakiri province, and Mondulkiri province. In addition, the number of electric cars in this case study is five and the locations of these vehicles are known in advance in the morning and evening to determine their routes.

III. RESULTS AND DISCUSSION

The optimization problem with the objective function of (1) subject to the constraints of (2-5) is developed in MATLAB.

A case study consists of separating a day into two even time zones (morning and evening), selecting ten possible charging stations and five electric cars. The model solves the problem to optimally select the charging stations to be built while satisfying the constraints. Because of the data and restrictions entered, the model successfully showed the charging status of the vehicles in each time period and the average results. This demonstrates which of the possible charging stations must be built according to the received road and charge status information.

For results charging status at each time at each charging location. If a vehicle is being charged in a station, the solution of Variable x indicates at any time period as shown in the results. Through the solution of Variable yj, the optimal charging stations are as follows:

- Phnom Penh (PP)
- Svay Rieng province (SVR)
- Sihanoukville (SHV)
- Preah Vihear province (PVH)
- Stung Treng province (STR)

Yj		VEHICLE	Morning	Evening	Yj		VEHICLE	Morning	Evening
1	PP	V1	0	0	0	SR	V1	0	0
		V2	0	0			V2	0	0
		V3	1	0			V3	0	0
		V4	0	0			V4	0	0
		V5	0	0			V5	0	0
1	SVR	V1	1	0	1	PHV	V1	0	0
		V2	0	0			V2	0	0
		V3	0	0			V3	0	0
		V4	0	0			V4	0	1
		V5	0	0			V5	0	0
1	SHV	V1	0	0	1	STR	V1	0	0
		V2	1	0			V2	0	0
		V3	0	0			V3	0	0
		V4	0	0			V4	0	0
		V5	0	0			V5	1	0
0	KK	V1	0	0	0	RTK	V1	0	0
		V2	0	0			V2	0	0
		V3	0	0			V3	0	0
		V4	0	0			V4	0	0
		V5	0	0			V5	0	0
0	BTB	V1	0	0	0	MDK	V1	0	0
		V2	0	0			V2	0	0
		V3	0	0			V3	0	0
		V4	0	0			V4	0	0
		V5	0	0			V5	0	0

Table. 1 Results charging status at each time at each charging location

For average results charging status at each time at each charging location. If a vehicle is being charged in a station, the solution of Variable x indicates at any time period as shown in the average results. Through the solution of Variable yj, the optimal charging stations are as follows:

- Phnom Penh (PP)
- Svay Rieng province (SVR)
- Sihanoukville (SHV)
- Preah Vihear province (PVH)
- Stung Treng province (STR)

Yj		VEHICLE	Morning	Evening	Yj		VEHICLE	Morning	Evening
0.8995	PP	V1	0.1724	0	0.303	SR	V1	0	0
		V2	0.246	0.082			V2	0	0
		V3	0.2237	0			V3	0	0
		V4	0.0954	0			V4	0.2604	0.0426
		V5	0.08	0			V5	0	0
0.6352	SVR	V1	0.6127	0.013	0.9293	PHV	V1	0	0
		V2	0.0019	0.0004			V2	0	0
		V3	0.0056	0			V3	0	0
		V4	0.0005	0			V4	0	0.6011
		V5	0.0011	0			V5	0	0
0.1469	SHV	V1	0	0	0.929	STR	V1	0	0
		V2	0.4919	0			V2	0	0.1778
		V3	0	0.2028			V3	0	0
		V4	0	0			V4	0	0
		V5	0	0			V5	0.1911	0.5604
0.421	KK	V1	0	0	0.1674	RTK	V1	0	0
		V2	0	0			V2	0	0
		V3	0	0.1469			V3	0	0
		V4	0	0			V4	0	0
		V5	0	0			V5	0	0.1674
0.442	BTB	V1	0	0	0.2019	MDK	V1	0	0.2019
		V2	0	0			V2	0	0
		V3	0.421	0			V3	0	0
		V4	0	0			V4	0	0
		V5	0	0			V5	0	0

Table. 2 Average results of charging status at each time at each charging location

After we get the Results charging status at each time at each charging location and Average results of charging status at each time at each charging location, we propose the optimal case to compare Average position of vehicles at each charging station with other fives case as shown in Fig.5.

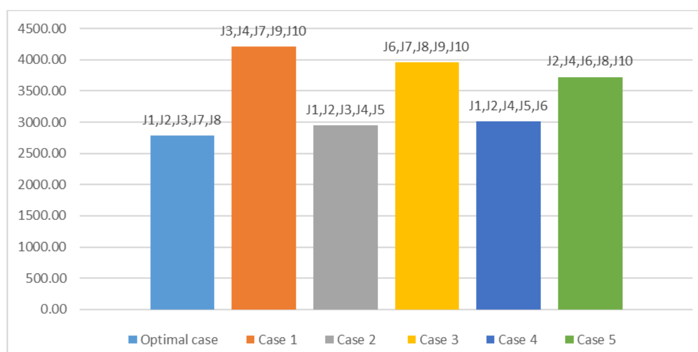

Fig. 5 Average position of vehicles at each charging station

Moreover, we also compare average minimum distance of different selected each charging stations for our optimal cases that selected five to six selected, seven selected, eight selected, nine selected and ten selected as shown in Fig.6.

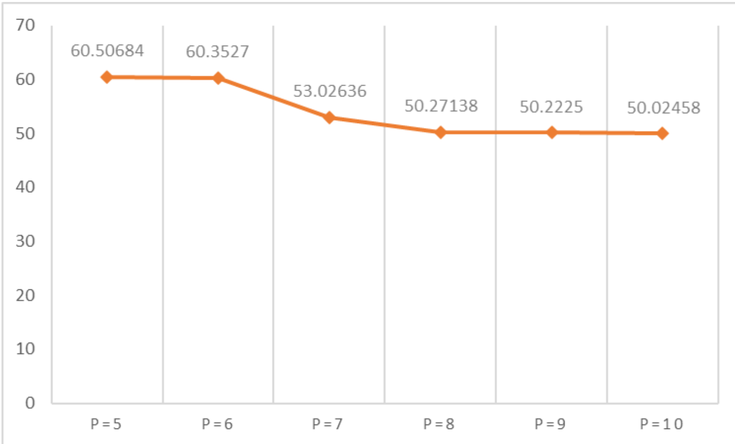

Fig. 6 average minimum distance of different selected each charging stations

IV. CONCLUSION

After verifying from compare the optimal case with five other cases and the average minimum distance of different selected charging stations with six others chosen, we assume the position of the vehicle that we selected by MATLAB using Mixed-integer linear programming (MILP) method is correct as the table and figure above.

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OS2-4

Prototype of a Simple Spectrometer Using Camera and Image Analysis Software

Siyan ZHU*, Motoharu FUJIGAKI

* University of Fukui

Abstract

In hydroponics, the wavelength distribution of the light source is an important factor. In general, spectrometers on the market are expensive. However, it is easy to make a spectrometer using a diffraction grating at a low price because the principle is simple. We explain how to make a spectrometer using a diffraction grating and a camera with an image analysis software.

The 10HS, MEC10, and MS10 Soil Moisture Sensor Calibration

Bunrong Proeung
Department of Telecommunication and Network Engineering
Institute of Technology of Cambodia
Phnom Penh, Cambodia
bunrongproeung@gmail.com

Chanthan Hel
Department of Telecommunication and Network Engineering
Institute of Technology of Cambodia
Phnom Penh, Cambodia
chanthan@itc.edu.kh

Rothna Pec
Department of Telecommunication and Network Engineering
Institute of Technology of Cambodia
Phnom Penh, Cambodia
rothna@itc.edu.kh

Sopheaktra chhorn
Department of Telecommunication and Network Engineering
Institute of Technology of Cambodia
Phnom Penh, Cambodia
pheaktra@itc.edu.kh

Mengheak Phol
Department of Hydrology and Water Resource Engineering
Institute of Technology of Cambodia
Phnom Penh, Cambodia
Pholmengheak1999@gmail.com

Channtola Sot
Department of Hydrology and Water Resource Engineering
Institute of Technology of Cambodia
Phnom Penh, Cambodia
channtola.sot@gmail.com

***Abstract*— The main purpose of this paper is to execute the calibration of soil moisture sensors and to know the accuracy whether the measurement is perfect, since soil moisture sensor are a technique for improving irrigation water management. Sensor calibration is an adjustment or combination of adjustments conducted on a sensor to ensure that it operates correctly and without mistakes as feasible. The experimental characterization was designed to learn how the selected sensor works in a well-controlled soil environment. For this purpose, clean silica sandy and loam sandy were chosen, as well as sensors such as MEC10, MS10, and 10HS. Because the meter data loggers were not used in this calibration, non-METER data recorder sensor readings were replaced. The MEC10 and MS10 are RS485 Modbus sensors that are always used with the Modbus Poll application to read data during measurement and require additional programming to read 10HS. However, Arduino programming was used to receive 10HS sensor data. The 10HS sensor measures voltage and converts it to percentages that represent the volumetric water content (VWC). By using the three different types of sensors, the standard deviation and maximum-minimum difference of each sensor were found by comparing the same type of sensor and verifying each sensor with linear and polynomial equations to know which of these equations was best for each sensor. The full-scale errors from 0% to saturated soil (0-40% and 0-35%) from the linear and polynomial equation were found for the verification. Since the 10HS already has the standard equation, it just verifies with the new polynomial order 3 equation from the voltage measured, and the other sensors were verifying the linear with the polynomial order 3 equation as normal. Each sensor of the same type performs approximatively. So, one of them is used to determine the full-scale error for verification. As a result, each sensor performed well. Two types of soil experiments using the same procedures and in the same environment indicate that the repeatability of sensor performance in another soil can be determined. Because there was no homogeneity in the water and soil mixture and poor soil placement, the measurement contains some errors, however, the maximum-minimum differences that were measured in 10 times of each water level are acceptable, and comparing the same types of sensors we saw the reading performance is approximated. All sensors responded linearly to changes in soil moisture, indicating that the calibration equations measured in these tests can be used to calibrate the sensors evaluated to improve their accuracy in the different soils used in these experiments. All the sensors that were used in this calibration should be used the polynomial order 3 equation because the full-scale errors are better than linear. After calibration, all of these sensors can be implemented in the controller.**

Keywords— Sensor calibration, 10HS, MEC10, MS10, Soil Moisture Sensor,

Title: The Mobile Application of Smart Irrigation Scheduling for Rice Framing in Cambodia

Dararith Khun, Chenda Lai, Chan Arun Phoeurn, Chanthen Hel, Pinnara Ket, Lengthong Kim

Abstract

The traditional methods of irrigation used in rice farming can be water-intensive and inefficient, leading to water waste and reduced crop yields while smart irrigation technology has the potential to overcome those problems. But the implementation of such technology can be challenging for small-scale farmers. A mobile application (app) has been designed and developed to integrate with smart irrigation technology to simplify the process of scheduling irrigation for rice farming in Cambodia. The smart scheduling feature of the mobile application is based on a combination of historical data and real-time data that receive from weather APIs and soil moisture sensors which includes weather patterns and soil moisture levels. Under analyzing of a new algorithm, the app takes into account factors such as crop type, soil type, and weather patterns specific to rice farming in Cambodia to provide personalized irrigation recommendations to the user with a user-friendly interface to display the recommended irrigation schedule. Users can view real-time information on their water usage and receive alerts on their mobile devices when the system detects unusual conditions, such as heavy rain or water leakage. To ensure the reliability and accuracy of the mobile application, The app requires a stable internet connection, as real-time data is constantly being collected. However, once the app is set up and running, it can greatly improve water management and crop productivity for farmers. The app is available in Khmer language, the official language of Cambodia, and English, and features a simple and intuitive user interface. The app is optimized for low-bandwidth internet connections, ensuring that it can be used even in remote rural areas to guarantee the data collection and analyzing correctly for the daily irrigation schedule for the selected location and making it a valuable tool for any rice farmer looking to improve their irrigation practices in Cambodia.

Testing a single ring infiltrometer for Beerkan infiltration experiments

Sophanith THA[1*], Channtola SOT[1], Mengheak PHOL[1], Nachy LY[1], Lengthong KIM[2] Chan Arun PHOEURN[2], Chenda LAI[2], Pinnara KET[2]

[1]*Master program of Water and Environmental Engineering, Graduate school, Institute of Technology of Cambodia*
[2]*Faculty of Hydrology and Water resource engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, 12156 Phnom Penh, Cambodia*
** Corresponding author: tha_sophanith@gsc.itc.edu.kh*

Abstract

The Beerkan is a method used to measure the amount of water that seeps into the soil, as the important parameters for smart irrigation. In this study, the single infiltrometers with two different diameters were used to the test under various experimental conditions for the Beerkan infiltration experiment to determine the saturated soil hydraulic conductivity (K_s). In the Cambodian Agricultural Research and Development Institute, Phnom Penh, Cambodia, the experiments were carried out (CARDI). At this purpose Data from experimental tests as well as analytical data obtained were used. This study contributes in defining the practical methods for measuring in-situ soil infiltration.

Keywords: *Beerkan method, Infiltrometer, soil hydraulic conductivity K_s*

Assessing irrigation water balance for rice production in Cambodia

Chantria CHHEANG[1*], Channtola SOT[2], Mengheak PHOL[2], Nachy LY[2], Lengthong KIM[3], Chan Arun PHOEURN[3], Chenda LAI[3], Pinnara KET[3]

[1]Undergraduate student, Faculty of Hydrology and Water resource engineering, Institute of Technology of Cambodia

[2]Graduate student, Master program of Water and Environmental Engineering, Graduate school, Institute of Technology of Cambodia

[3]Faculty of Hydrology and Water resource engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, 12156 Phnom Penh, Cambodia

** Corresponding author: chantriachheang@gmail.com*

Abstract

Rice is the most important crop cultivated in Cambodia covered over 70% of agricultural cropped areas. However, assessing irrigation demand for rice cultivation in different areas is limited. In this study, we estimated the crop water requirement (CWR) for rice production using models, CROPWAT 8.0 and CLIMWAT 2.0 in different rice cultivated zones in Cambodia. The result showed the different ranges of the CWR. Water balance analysis indicated the important of evapotranspiration the importance of crop evapotranspiration and percolation in different areas. This study is important for efficient water resources management.

<u>Topic</u>: Estimation of Canopy Cover for rice using Smartphone photography

Mengheak PHOL [1*], Channtola SOT [1] SOY Makara[1], Nachy LY[1], Sathea YAN[2], Chenda LAI[3,]
Lengthong KIM[3], Chan Arun PHOEURN[3], Pinnara KET[3]

[1] *Graduate student, Master program of Water and Environmental Engineering, Institute of Technology of Cambodia*

[2]*Undergraduate student, Faculty of Hydrology and Water resource engineering, Institute of Technology of Cambodia*

[3]*Faculty of Hydrology and Water Resource Engineering, Institute of Technology of Cambodia,*
Russian Federation Blvd., P.O. Box 86, 12156 Phnom Penh, Cambodia.
**Corresponding author:* phol_mengheak@gsc.itc.edu.kh

Abstract

Besides the relationship between photosynthetic activity, crop biomass, and grain output, canopy cover (green areas) must be evaluated to calculate a crop's biomass and grain yield. The canopy cover (CC) variable may accurately predict two measurements of plant growth factors: the leaf area index and aboveground biomass. There are several ways to calculate canopy cover, some of which are damaging, expensive, and inconvenient. This work aimed to create a low-cost method for quickly learning about rice development using digital images obtained with a smartphone. With digital smartphone images of rice fields, the ratio of plant pixels to total pixels was utilized to calculate canopy cover (CC). Canopy parameter, namely, the canopy volume parameter (CVP), was proposed and developed for rice using the leaf area index (LAI) and plant height (PH). Among these parameters, the CVP was selected as an optimal parameter to characterize rice yields during the growth period. Image feature parameters were extracted, including the canopy cover (CC) and numerous vegetation indices (VIs), before and after image segmentation. A rice CVP prediction model in which the CC and VIs served as independent variables was established using a random forest (RF) regression algorithm. The results revealed the following. The CVP was better than the LAI and PH for predicting the final yield. These results show that digital photographs may be used to estimate rice yields and follow crops' development over time.

Keywords: *Canopy cover, Digital images, Images segmentation, rice yield.*

Prediction of soil organic carbon stock using visible and near infrared reflectance spectroscopy (VNIRS)

Nachy LY[1*], Channtola SOT[1], Mengheak PHOL[1], Sophanith THA[1], Sathea YAN[2], Lengthong KIM[3], Chan Arun PHOEURN[3], Ratha Muon[3], Chenda LAI[3], Pinnara KET[3], Boreborey TY[3], Pascal Jouquet[4].

[1]*Graduate student, Master program of Water and Environmental Engineering, Graduate school, Institute of Technology of Cambodia*

[2]*Undergraduate student, Faculty of Hydrology and Water resource engineering, Institute of Technology of Cambodia*

[3]*Faculty of Hydrology and Water resource engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, 12156 Phnom Penh, Cambodia.*

[4]*Laboratoire d'Ecologie des Sols Tropicaux, IRD, 32 Avenue H. Varagnat, 93143 Bondy Cedex, France*

* *Corresponding author: nachy_ly@gsc.itc.edu.kh*

Abstract

There is increasing demand for data on soil organic carbon (SOC) stock (SSOC; KgC m^{-2}), but the acquisition of such data, which relies on the determination of volumetric SOC content (SOCv; gC dm^{-3}), is often tedious or complex. Visible and near infrared reflectance spectroscopy (VNIRS) has proven useful for soil characterization, but has rarely been used for direct prediction of SOCv. The objective of this work is to predict SOCv using VNIR spectra from soils of different land uses in Chhnuk Trou, Kampong Chhnang province, Cambodia.

Considering the total set of laboratory spectra, predictions in independent validation (leave-one-site-out) yielded SOCv and SSOC predictions using standard errors of prediction were good accuracy. This result was achieved using local partial least squares regression (PLSR).

Finally, this work demonstrated that SSOC could be quantified accurately using a VNIRS library built on archive soil samples, which offers important perspectives for SSOC accounting.

Keywords: *Diffuse reflectance spectroscopy; Global PLS regression; Local PLS regression*

Image Processing for rice coverage estimation using different methods.

Sathea YAN[1*], Channtola SOT[2], Mengheak PHOL[2], Nachy LY[2], Lengthong KIM[3], Chan Arun PHOEURN[3], Chenda LAI[3], Pinnara KET[3]

[1]Undergraduate student, Faculty of Hydrology and Water resource engineering, Institute of Technology of Cambodia
[2]Graduate student, Master program of Water and Environmental Engineering, Graduate school, Institute of Technology of Cambodia
[3]Faculty of Hydrology and Water resource engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, 12156 Phnom Penh, Cambodia
** Corresponding author: yan_sathea@dtc2.itc.edu.kh*

Abstract

The value of canopy cover (CC) is an important index for rice growth stages observation and cultivation management. The currently used methods to determine the CC using image base technique are developed such as Adobe Photoshop, Canopeo App, ImageJ Software. However, comparison of the techniques is not presented. In this study, we compared those technique to investigate its accuracy using linear regression model for estimating the CC of Rice growth in Kampong Thom province, Cambodia. This study can be a contribution for defining the practical technique to monitor the rice growth.

Do biochar and cow manure compost affect the field capacity of different soil types?

Channtola SOT[1*], Mengheak PHOL[1] Sophanith THA[1], Nachy LY[1], Sathea YAN[2], Chenda LAI[3], Lengthong KIM[3], Chan Arun PHOEURN[3], Pinnara KET[3]

[1] *Graduate student, Master program of Water and Environmental Engineering, Graduate school, Institute of Technology of Cambodia*

[2]*Undergraduate student, Faculty of Hydrology and Water resource engineering, Institute of Technology of Cambodia*

[3]*Faculty of Hydrology and Water Resource Engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, 12156 Phnom Penh, Cambodia.*

**Corresponding author: sot_channtola@gsc.itc.edu.kh*

Abstract

Biochar and cow manure compost are widely suggested as a soil amendment to improve soil physical properties for rice cultivation. However, the investigate of the effect of the soil amendments on soil water content held at the field capacity (FC), the crucial indicator for smart irrigation scheduling, is rarely documented. In this study, we conducted an experiment to investigate the effect of biochar and cow manure compost on FC by using ceramic pressure plate. The different soil samples from Prah Teah Lang and Prey Khmer soil type in Cambodia was used for the experiment. The result showed the improvement of FC in both soil types. This study allows better understanding the impact of soil amendment on soil water content.

Keywords: *Field Capacity, Biochar, Cow manure, Soil types*

OS4-4

Non-Contact Displacement Distribution Measurement Using Optical Sensing and Image Analysis

Motoharu FUJIGAKI *

* *University of Fukui*

Abstract

Non-contact displacement distribution measurement and 3D shape and deformation measurement are used in many industrial fields such as manufacturing, FA, visual inspection, and health monitoring. Phase analysis method for the projected grating or attached grid is one of the effective and accurate method. In this presentation, several non-contact displacement distribution measurement methods using optical sensing and image analysis proposed by our laboratory are introduced.

Plagiarism Detection System for Khmer Language

Mr. HUON Sophy[1] and Dr. VALY Dona[2]

[1] *Graduate student, Master program of Engineering in Computer Science, Graduate school, Institute of Technology of Cambodia*

[2] *Department of Information and Communication Engineering, Institute of Technology of Cambodia,*

Russian Federation Blvd., P.O. Box 86, 12156 Phnom Penh, Cambodia.
**Corresponding author: sophy_huon@gsc.itc.edu.kh*

Abstract

Plagiarism is the act of using someone else's work without proper acknowledgement. It is one of the most concerning misconducts in academia especially in recent years due to an easy access to electronic documents on the web. Without any tool to detect plagiarism, students might be able to use work of others as their own. Plagiarism detection system is an ongoing research study and it has been successfully developed for language such as English. In the best of our knowledge, plagiarism detection approaches for Khmer texts, however, are still lacking. In this research work, we propose to develop a plagiarism detection framework to find duplicated texts and similarities of an input text in a document (document to be analyzed) compared to existing referenced documents. The framework is designed to accommodate different characteristics and properties of Khmer language and script. The framework consists of two principal modules: the construction of referenced text corpus and the development of a plagiarism detection system for documents written in Khmer.

Keywords: *Machine Learning, Natural Language Processing, Corpus Construction, Plagiarism Detection*

Masked Language Modeling for Khmer Palm Leaf Manuscript

Sothy Sek, Dona Valy
Department of Information and Communication Engineering
Institute of Technology of Cambodia
Phnom Penh, Cambodia
sothysek93@gmail.com, dona.valy@gmail.com

Abstract

In Cambodia, palm leaf manuscripts were used to record documents about knowledge, science, culture, religion, law, theory, and more. These manuscripts contain very useful information that the next generation of Cambodians can use to study. In order to preserve these historical documents, these manuscripts have been digitized and centralized. Since the **SleukRith Set [1]** is already complete, we are going to use this dataset for the document analysis. The Khmer language is very complex compared to other languages; spelling mistakes are common. In some cases, two or more spellings of a word are correct. In other cases, words are misspelled because they sound similar. Moreover, the process of word segmentation from the dataset also produces misspellings due to the noise in the images or degradation. That is why **Masked Language Modeling** is present. This study is an overview of the deep learning-based approach to solving the problem using the **Recurrent Neural Network.**

Keywords : Masked Language Modeling, Recurrent Neural Network

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Word Spotting on Khmer Palm Leaf Manuscript Documents

Vannkinh Nom, Dona Valy
Department of Information and Communication Engineering
Institute of Technology of Cambodia
Phnom Penh, Cambodia
vannkinhnom123@gmail.com, dona.valy@gmail.com

Abstract. Word spotting is a crucial task in the field of document analysis, especially for ancient palm leaf manuscripts. In particular, Khmer palm leaf manuscripts, which are written on long rectangular cut and dried palm leaf sheets, are an important cultural heritage for Cambodia. These manuscripts contain valuable historical, religious, and linguistic information, and their preservation is crucial. However, due to the fragile nature of these documents, their age and the complex of Khmer writing and how words are formed, it is often difficult to extract the information contained within them. This is where word spotting comes into play, as it allows for efficient and accurate identification of specific words or phrases within the document. The process involves text localization and a text recognition module. Since text recognition on Khmer palm leaf manuscripts has been conducted, this research work focuses on text localization by building a Region Proposal Network (RPN) using You Only Look Once (YOLO) technique which is an algorithm in computer vision used for object detection. We evaluated our proposed method by utilizing the public Khmer Palm Leaf Manuscript Dataset called SleukRith Set which contains around 657 pages using evaluation metrics like F1-score and mAP.

Keyword: Text recognition, Text localization, You Only Look Once (YOLO), Region Proposal Natwork (RPN)

Text-image reconstruction and reparation for Khmer Historical Documents

Chanchen Pork, Dona Valy
Department of Information and Communication Engineering
Institute of Technology of Cambodia
Phnom Penh, Cambodia
chenpork.chen@gmail.com, dona.valy@gmail.com

Abstract. Text-image reconstruction and reparation are vital aspects of preserving historical documents, especially in the term of improving their accessibility and readability for scholars and the general public. In Cambodia, the Khmer palm leaf script is a unique and significant part of Cambodia's heritage and an important resource for understanding the region's history and culture. Unfortunately, many of these documents have been damaged over time due to natural disasters, war, neglect and other factors. This resulted in the loss of valuable information . To address this problem, this study proposes a text image reconstruction and reparation framework that uses advanced computer vision and deep learning techniques. The framework aims to combine image processing and deep learning techniques to reconstruct original text and repair damaged images in Khmer historical documents. The damaged text is then reconstructed and the missing characters are filled in by deep learning models. The proposed framework uses a pair of deep learning techniques such as Convolutional neural networks (CNN) and Generative adversarial networks (GAN) trained on processed data images. For data processing, we remove some patterns of character images and feed them to the training model to fill in the missing part. Each deep learning model will be evaluated based on several metrics, including accuracy, completeness, and similarity to the original image. After evaluation, a deep learning model which has the higher performance score will be selected. The result of this research is significant in the preservation and restoration of cultural heritage and as an aid in the restoration and preservation of historical documents.

Keyword: Text-image, image processing, image reconstruction, deep learning, model, convolutional neural networks (CNN), Generative adversarial networks (GAN)

P-5

Optimization of Lab In-Verssel Throught C:N Ratio Varation of Composting Process And Quality

Vichhey NALL*, Solida OUN[1], Pinnara KET[2], Rothborey CHAN[2], Boreybore TY[2] , Chanthan HEL[2]

* *Institute of Technology of Cambodia*

1 Faculty of Hydrology and Water Resources Engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, Phnom Penh, Cambodia

2 Research and Innovation Center, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, Phnom Penh,

3 Department of Telecommunications and Networking Engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, Phnom Penh, Cambodia.