International Journal of Ubiquitous Computing (IJUC)

ISSN : 2180-1355

Volume 1, Issue 2

Number of issues per year: 6

INTERNATIONAL JOURNAL OF UBIQUITOUS COMPUTING (IJUC)

VOLUME 1, ISSUE 2, 2011

EDITED BY
DR. NABEEL TAHIR

ISSN (Online): 1985-2312

International Journal of Ubiquitous Computing is published both in traditional paper form and in Internet. This journal is published at the website http://www.cscjournals.org, maintained by Computer Science Journals (CSC Journals), Malaysia.

IJUC Journal is a part of CSC Publishers
Computer Science Journals
http://www.cscjournals.org

INTERNATIONAL JOURNAL OF UBIQUITOUS COMPUTING (IJUC)

Book: Volume 1, Issue 2, August 2011
Publishing Date: 31-08-2011
ISSN (Online): 1985-2312

IJUC Journal is a part of CSC Publishers
http://www.cscjournals.org

Published in Malaysia

Typesetting: Camera-ready by author, data conversation by CSC Publishing Services – CSC Journals, Malaysia

CSC Publishers, 2011

EDITORIAL PREFACE

This is the second issue of volume one of International Journal of Ubiquitous Computing (IJUC). The Journal is published bi-monthly, with papers being peer reviewed to high international standards. The International Journal of Ubiquitous Computing is not limited to a specific aspect of engineering but it is devoted to the publication of high quality papers on all division of engineering in general. IJUC intends to disseminate knowledge in the various disciplines of the Computer Science field from theoretical, practical and analytical research to physical implications and theoretical or quantitative discussion intended for academic and industrial progress. In order to position IJUC as one of the good journal on Computer Sciences, a group of highly valuable scholars are serving on the editorial board. The International Editorial Board ensures that significant developments in Ubiquitous Computing from around the world are reflected in the Journal. Some important topics covers by journal are architectures, middleware, tools designs, Experiments, Evaluation, etc.

The initial efforts helped to shape the editorial policy and to sharpen the focus of the journal. Starting with volume 1, 2011, IJUC appears in more focused issues. Besides normal publications, IJUC intend to organized special issues on more focused topics. Each special issue will have a designated editor (editors) – either member of the editorial board or another recognized specialist in the respective field.

The coverage of the journal includes all new theoretical and experimental findings in the fields of engineering which enhance the knowledge of scientist, industrials, researchers and all those persons who are coupled with engineering field. IJUC objective is to publish articles that are not only technically proficient but also contains information and ideas of fresh interest for International readership. IJUC aims to handle submissions courteously and promptly. IJUC objectives are to promote and extend the use of all methods in the principal disciplines of Computing.

IJUC editors understand that how much it is important for authors and researchers to have their work published with a minimum delay after submission of their papers. They also strongly believe that the direct communication between the editors and authors are important for the welfare, quality and wellbeing of the Journal and its readers. Therefore, all activities from paper submission to paper publication are controlled through electronic systems that include electronic submission, editorial panel and review system that ensures rapid decision with least delays in the publication processes.

To build its international reputation, we are disseminating the publication information through Google Books, Google Scholar, Directory of Open Access Journals (DOAJ), Open J Gate, ScientificCommons, Docstoc and many more. Our International Editors are working on establishing ISI listing and a good impact factor for IJUC. We would like to remind you that the success of our journal depends directly on the number of quality articles submitted for review. Accordingly, we would like to request your participation by submitting quality manuscripts for review and encouraging your colleagues to submit quality manuscripts for review. One of the great benefits we can provide to our prospective authors is the mentoring nature of our review process. IJUC provides authors with high quality, helpful reviews that are shaped to assist authors in improving their manuscripts.

Editorial Board Members
International Journal of Ubiquitous Computing

TABLE OF CONTENTS

Volume 1 Issue 2 August 2011

Pages

Wireless Sensor Network for Tea Estate Monitoring in Complementally Usage With Satellite Imagery Data Based on Geographic Information System (GIS)

Kohei Arai *arai@is.saga-u.ac.jp*
Graduate School of Science and Engineering
Saga University
1 Honjo, Saga 840-8502 Japan

Abstract

Tea estate monitoring system with ground based camera system (sensor network) and meteorological stations as well as satellite imagery data on a Geophysical Information System (GIS) is proposed. Appropriate tea estates can be found with satellite imagery data with a reference of vitality of the tea trees in tea estates derived from ground based camera data. Satellite covers relatively wide areas in comparison to the ground based so that potentiality of the tea estate can be estimated with satellite imagery data. It is better to superimpose the satellite imagery data on topographic map data in determining appropriate tea estates so that GIS is used for such purpose. Meanwhile ground based camera system is appropriate for monitoring a growing process of tea leaves so that quality of tea leaves and for prediction of harvesting tea leaves.

Observation frequency of the satellite is smaller than that of the ground based camera system while observation coverage of the satellite is greater than that of the ground based camera system so that both can be used complementally. Tea estates are situated in un-accessible areas of radio wave for mobile phone and the other commercially available radio waves (in mountain tenuous areas as well as valley) so that wireless Local Area Network (LAN) access is mandatory for such areas. Network performance is evaluated as one of key issues for such communication link. GIS performance that is transmission rate of satellite imagery data and topological map data with the different map size and map scales is also evaluated.

Keywords: Sensor network, Remote sensing satellite imagery data, Geographic Information System, Local Area Network, Tea estate, Vitality of tea leaves

1. INTRODUCTION

It is highly desired to monitor vitality of crops in farm areas automatically with appropriate measuring instruments in order to manage farm area in an efficient manner. Vegetation monitoring is attempted with red and photographic cameras [1]. Grow rate monitoring is also attempted with spectral observation with remote sensing satellites and ground based monitoring systems [2].

This paper deals with a method for assessment of the vitality of tea estates with remote sensing satellite data and also tealeaves growing rate monitoring with ground based wireless sensor network. Usually, new tealeaves start to grow in the begging of April and grow-up rapidly. Theanine (amino-acid containing in the tealeaves) in new tealeaves increases in accordance with grow-up. Then Theanine changes to Catechin due to sun light so that Theanine decreases for the time being. Tea taste good if the tealeaves contain a lot of Theanine while it tastes bad for the tealeaves containing a lot of Catechin. It used to harvest before Theanine changes to Catechin, approximately in the late of April or the begging of May. After the harvesting the first new tealeaves, next new tealeaves grow-up again. Then second new tealeaves harvesting is done in the begging of July. Third harvesting is used to be scheduled in the September usually. After the third harvest, old tealeaves are cut for maintaining vitality of tea trees for a long winter time, during from October to March. These are annual events for tealeaves.

Taste of first harvested new tealeaves is the best followed by second and third harvested new tealeaves. The difference between first and the other two new harvested tealeaves is pretty large. In other word, most of tea farmers concentrate on first harvested new tealeaves rather than the other two harvested new tealeaves.

During six months of winter time, vitality of tea trees is assessed with remote sensing satellite data together with the proposed ground based camera monitor systems. Remote sensing satellite does not work for monitoring of grow process of new tealeaves because new tealeaves grow-up within a four weeks and revisit period of the satellite orbit does not allow monitoring tea estates. It is rare to observe tea estates from remote sensing satellite because of long revisit period and poor weather conditions during grow-up period. Therefore, ground based wireless sensor (cameras) network is needed in the sense of complementally usage with remote sensing satellites. Remote sensing satellite, however, does work for assessment of tea estate vitality because six month would be enough for acquisition of one or two of good remote sensing satellite data. GIS system [3] is proposed for assessments of tea estates through superimpose remote sensing satellite imagery data on topographic maps.

Usually tea estates are situated in mountainous regions, poor communication link environment so that only wireless network does work to transmit acquired camera data. On the other hand, automatic monitoring of a quality of tealeaves with network cameras together with a method that allows estimation of total nitrogen and fiber contents in tealeaves is also proposed in this paper.
The following chapter describes the proposed methods for tea estate vitality assessment and ground based wireless sensor network followed by experimental results and some discussion. Finally, concluding remarks is followed with some discussions.

2. PROPOSED METHOD

2.1. Tea Estate New Tealeaves Monitoring System With Network Cameras

The proposed tea estate monitoring system is illustrated in Figure 1.

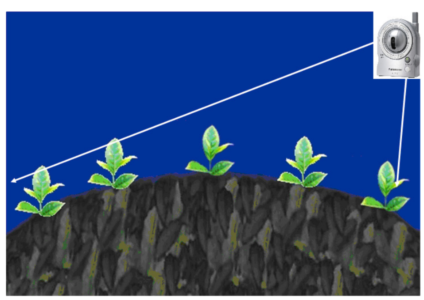


FIGURE 1: Illustrative view of the proposed vegetation monitoring system with two network cameras, visible and NIR.

Visible and NIR network cameras are equipped on the pole in order to look down with -5-95 degrees of incident angle which depends on the location as is shown in Figure 1. The pole is used for avoid frosty damage to the tealeaves using fan mounted on the pole. With these network cameras, reflectance in the wavelength region of 550nm (red color) and 870nm (NIR) are measured together with BRDF: Bi-direction Reflectance Distribution Function [4] assuming that vegetated areas are homogeneous and flat. BRDF is used for estimation of Grow Index (GI) and BRDF correction from the measured reflectance of the tealeaves.

Figure 2 shows the proposed system configuration of tea estate monitoring with wireless connected network cameras, weather station and its controller of mobile phone and internet terminals. Visible Pan-Tilt-Zoom:

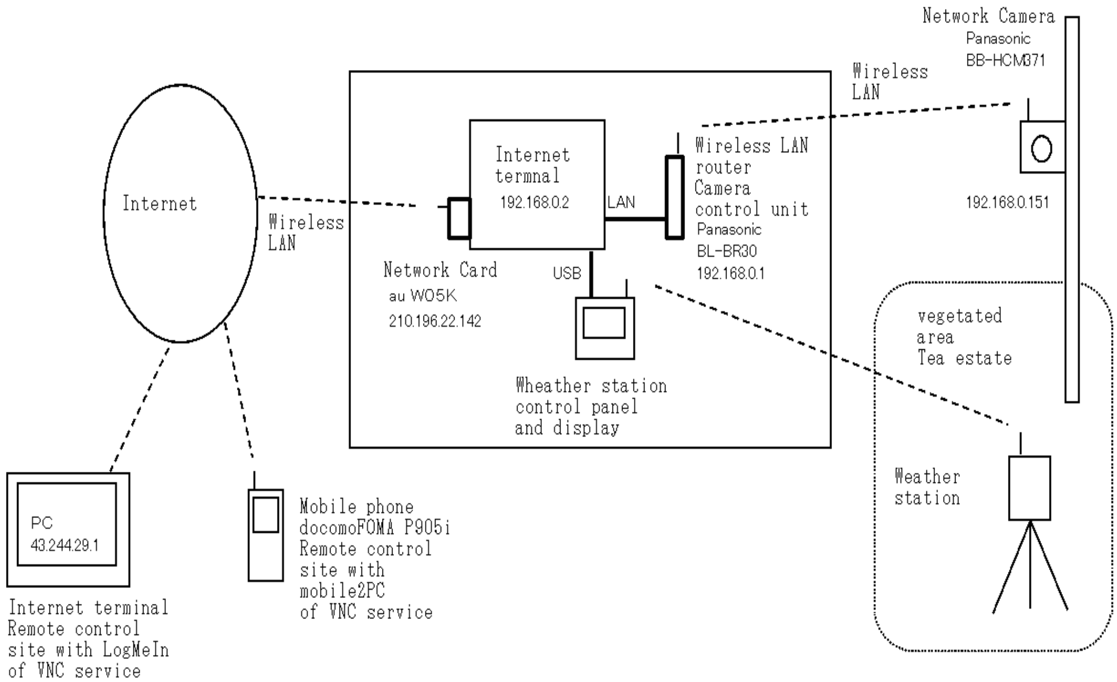
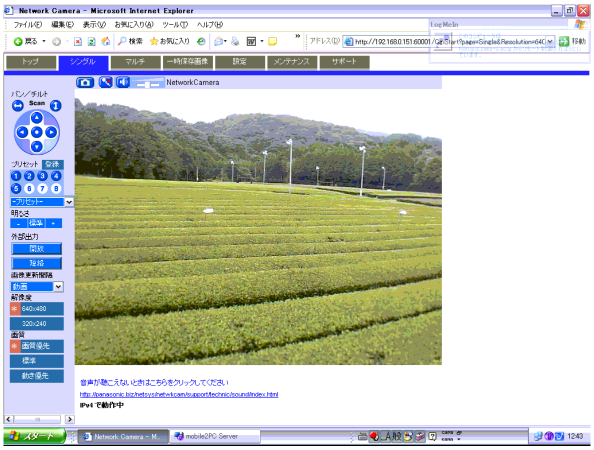


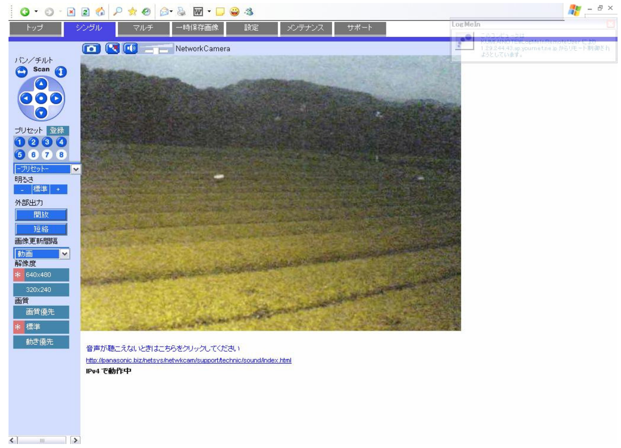
FIGURE 2: System configuration of tea estate monitoring with wireless connected network cameras, weather station and its controller of mobile phone and Internet terminals.

PTZ network camera and NIR filter (IR840) attached one is equipped on the pole. PTZ cameras are controlled by mobile phone with “mobile2PC” or Internet terminal with “LogMeIn” of VNC services [5] through wireless LAN connected Internet. Acquired camera data are used for estimation of total nitrogen and fiber contents as well as BRDF for monitoring grow index. An example of visible camera image acquired in daytime is shown in Figure 3 (a) while that for NIR camera image acquired in nighttime is shown in Figure 3 (b).

The cameras are connected to the Internet through the network card of W05K that is provided by AU/KDDI (Mobile phone provider). Through http://119.107.81.166:8080, the acquired image data are accessible so that it is easy to access the data from internet terminals. Panasonic BB-HCM371 cameras are used for the experiments. Solar panel of G-500(12V, 500mA, 8.5W) with battery of SG-1000 is used together with Xpower75 (60W) of inverter. On the other hand, weather station data can be accessible from the URL of http://katy.jp/mapstation/ of data server provider through wireless LAN connection from the weather station to the internet terminal. Figure 4 shows examples of the images displayed onto mobile phone. Not only camera imagery data, but also weather station data can be monitored with mobile phone. Figure 4 (a) and (b) shows overall weather station data of atmospheric pressure, solar direct and diffuse irradiance, leaf wetness, soil moisture, etc. and time duration of air-temperature and relative humidity of the tea estate while Figure 4 (c) shows web camera imagery data.

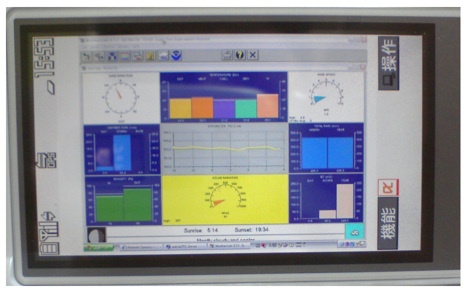


(a) Daytime

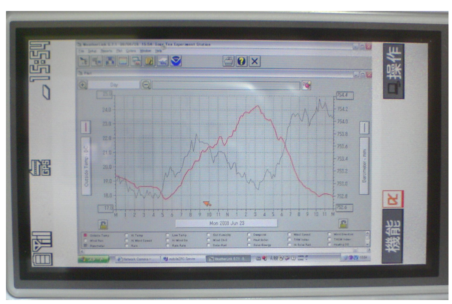


(b)Nighttime

FIGURE 3: Examples of visible camera images**.**



(a) Overall weather station data (wind direction and speed, air temperature, humidity, soil moisture, tealeaves wetness, solar irradiance, rain rate, atmospheric pressure etc. can be monitored with mobile phone).



(b) Air-temperature and relative humidity (diurnal change, weekly changes can be monitored with mobile phone).

(c) Camera image data (natural colored image and near infrared image are monitored with mobile phone)

FIGURE 4: Data displayed onto mobile phone

It is possible to estimate nitrogen and fiber contents in new tealeaves using regressive equation between near infrared reflectance [6] and nitrogen as well as fiber contents.

Near infrared reflectance can be calculated with camera images. Through visual perception, a portion of image of flatly situated new tealeaves is extracted in the acquired camera images. Then near infrared reflectance is calculated by comparing pixel values of new tealeaves and that of Spectralon (standard reflectance plaque of which spectral reflectance is ensured in a laboratory basis). Thus quality of new tealeaves (nitrogen and fiber contents) and growing situation can be monitored with network cameras.

2.2. Tea Estate Vitality Assessment Method With Remote Sensing Satellite Imagery Data on Topographic Maps With GIS System

A method for assessment of tea estates with remote sensing satellite imagery data on topographic maps with GIS system is proposed. Figure 5 shows an example of screen image of the proposed GIS system. Figure 5(a) shows an example of topographic maps while Figure 5 (b) shows an example of thematic maps of vitality of tea estates. Due to the fact that vitality of tea tree is highly correlated to reflectance at near infrared wavelength region, near infrared band of remote sensing satellite imagery is used for assessment of tea tree vitality. Meanwhile Figure 5(c) shows an example of remote sensing satellite data and corresponding location of topographic map. Shrinking and enlargement can be done with mouse operation.

As is mentioned later, greater than 6% of nitrogen contents and less than 18% of fiber content in the new tealeaves has to be ensured for good qualified new tealeaves. In order to ensure, greater than 4% of nitrogen content and less than 18% of fiber content is mandatory for old tealeaves in the tea estates in concern during a winter season. It is possible to estimate nitrogen and fiber contents using near infrared band data of remote sensing satellites. Thus tea tree vitality can be assessed with satellite data with GIS system.

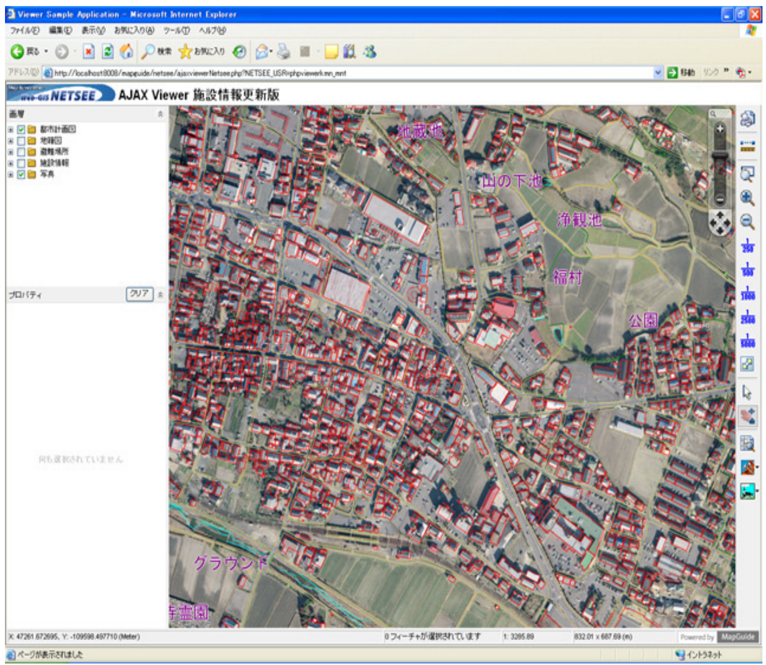
Figure 6 shows an example of GIS representation of tea estates of topographic map and the acquired images of tea estate in visible and near infrared camera monitoring system. As is indicated in Figure 6, network camera acquires image along with the tealeaves line with visible and near infrared wavelength region. Meanwhile, Figure 7 shows an example of satellite image of northern Kyushu including tea estates of Saga Prefectural Institute for Tea: SPIT which is situated in Ureshino, Saga Japan which was acquired on February 26 2007. Figure 7(a) shows one scene of ASTER image while Figure 7(b) shows the portion of image of SPIT tea estates and surroundings.

At the top-right corner, spectral reflectance of tea estates derived from the ASTER image is indicated while whole scene of image is also displayed at the bottom-left corner. Meanwhile, false colored ASTER image of SPIT tea estates on the corresponding topographic map is shown in Figure 7(c) while the estimated nitrogen content in tealeaves is shown in Figure 7(d). Thus tea estate vitality (Nitrogen content in tealeaves) can be assessed with ASTER imagery data on the corresponding topographic map. Then potential ability of tealeaves quality can be assessed by tea estate by tea estate.

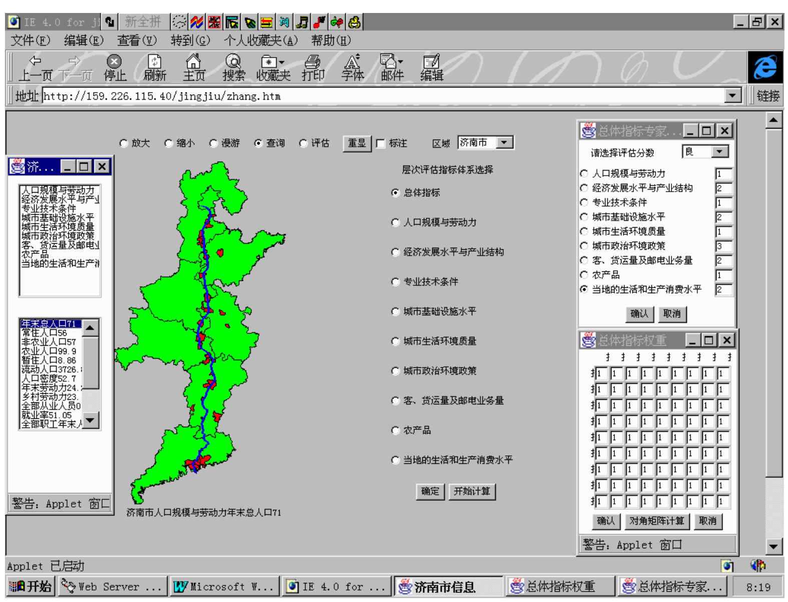
Regressive equations of nitrogen and fiber contents in tealeaves are as follows,

$$TN = 22.474 Ref_{870} - 10.177 \quad (1)$$
$$F\text{-}NIR = -22.886 Ref_{870} + 16.699 \quad (2)$$

where *TN* and *F-NIR* denote Total Nitrogen and Fiber content in tealeaves. R square value for *TN* is 0.736 while that for *F-NIR* is 0.742 so that it may say that *TN* and *F-NIR* can be estimated with reflectance at 870nm (Near infrared) derived from NIR network camera.



(a) Example of topographic map of tea estates



(b) Thematic map of tea estates

(c) Topographic map (left) and remote sensing satellite imagery (Terra/ASTER on the right) can be superimposed and enlarged easily

(d)

FIGURE 5: An example of screen images of the proposed GIS system

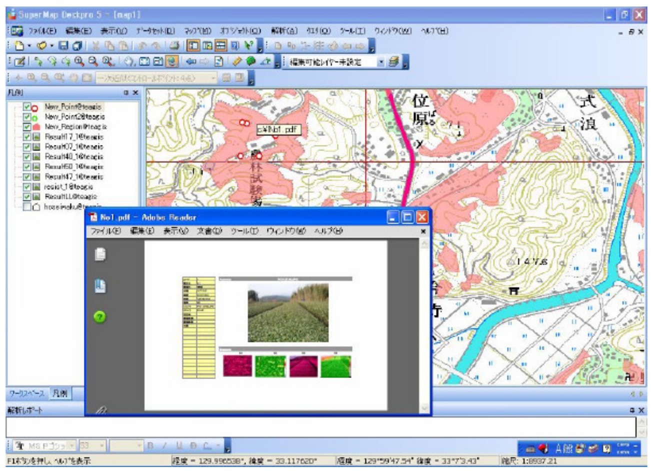
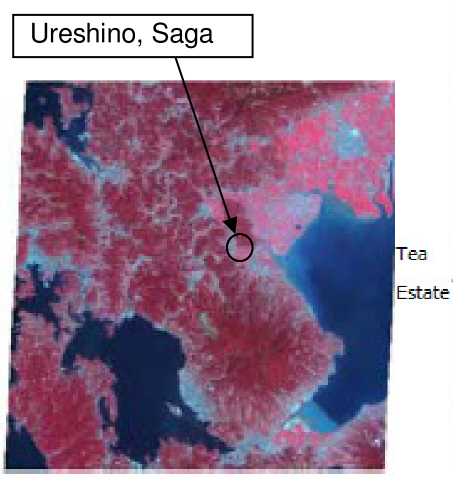
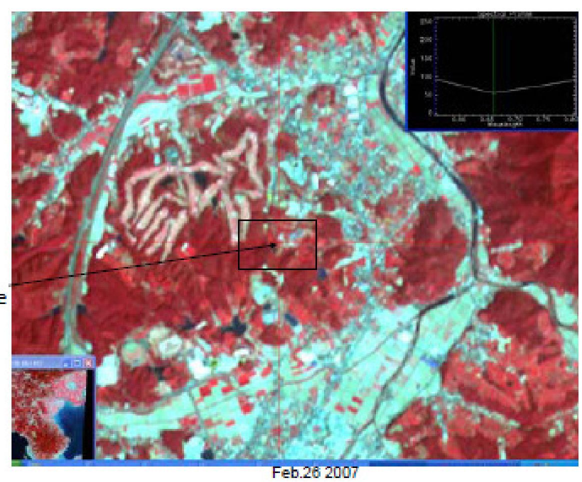


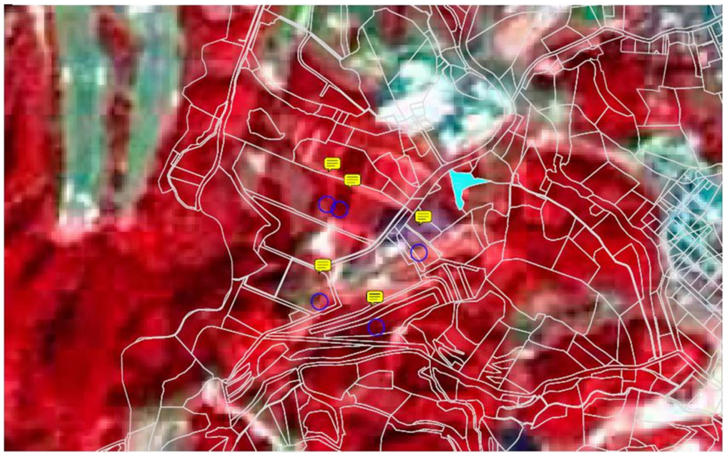
FIGURE 6: An example of screen image of GIS system (topographic map and ground based camera monitor image of tea estate in visible and near infrared wavelength regions)



(a) ASTER image



(b) Extracted portion of ASTER image of Ureshino tea estate

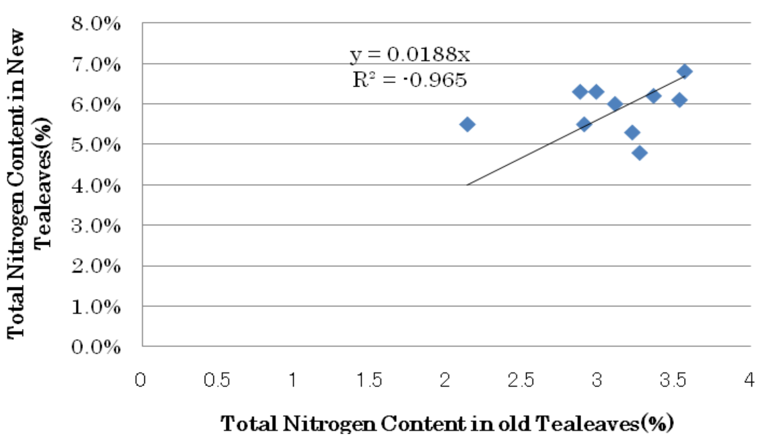


(c)Saga Prefectural Institute for Tea: SPIT and an example of ASTER image of SPIT on the topographic map (GIS representation): Blue circles and yellow comment boxes indicate the test site of East, South, West, and North tea estates situated in SPIT.

(d) Estimated nitrogen content in tealeaves with regressive equation between near infrared reflectance and nitrogen content

FIGURE 7: Estimation of nitrogen content in new tealeaves on GIS system

Using ASTER imagery data, nitrogen content in old tealeaves is estimated during winter time period while nitrogen content in new tealeaves is estimated with near infrared camera data during harvesting time period, the beginning of May. Both are highly correlated with 0.965 of R square value as is shown in Figure 8.



Nitrogen Content	
Old	New
298%	6.30%
357%	6.80%
353%	6.10%
311%	6.00%
291%	5.50%
336%	6.20%
327%	4.80%
322%	5.30%
214%	5.50%
288%	6.30%

FIGURE 8: Relation of total nitrogen contents in between old (Winter season) and new tealeaves (Harvesting time period: in the biggeing of May)

The right table of Figure 8 shows relation between old and new tealeaves. The left column shows averaged nitrogen content of old tealeaves measured on the three different days while right column shows measured nitrogen content of harvested new tealeaves. Thus it is concluded that there is a high correlation of nitrogen contents in between old and new tealeaves results in vitality of tea tree in tea estates can be estimated through estimation of nitrogen content of old tealeaves in winter season.

3. CONCLUSIONS

The proposed new tealeaf quality and quantity monitoring system with network cameras is validated with tea estates at the SPIT: Saga Prefectural Institute for Tea situated at Ureshino, Saga, Japan together with tea tree vitality assessment with ASTER imagery data. Namely tea tree vitality is highly correlated to the quality of new tealeaves (nitrogen content) measured with ground based infrared camera. The estimated nitrogen content can be displayed on geographical map image with GIS system so that new tealeaves quality is assessed with visible to near infrared radiometer data onboard remote sensing satellites. It is also possible to determine a most appropriate new tealeaves harvesting timing by means of the proposed method of nitrogen content in new tealeaves using ground based infrared camera network system to maximizing the estimated nitrogen content in new tealeaves. Theanine in new tealeaves[1] is changed to catechin through solar illumination. An appropriate new tealeaves harvesting timing can be determined through watching the nitrogen content in new tealeaves. Thus the most appropriate time for harvesting new tealeaves is determined.

Also it is possible to estimate mass and quality of new tealeaves based on monitored camera imagery data and satellite imagery data derived total nitrogen and fiber contents in the new tealeaves. It is obvious that nitrogen rich tealeaves tastes good while fiber rich tealeaves tastes bad. Theanine: 2-Amino-4-(ethylcarbamoyl) butyric acid that is highly correlated to nitrogen contents in new tealeaves are changed to catechin [8],[9],[10] due to sun light. In accordance with sun light, new tealeaves grow up so that there is a most appropriate time for harvest in order to maximize amount and taste of new tealeaves simultaneously.

ACKNOWLEDGEMENTS

Author would like to thank Dr. Hideo Miyazaki and Mr. Sadayuki Akashi of SPIT for their valuable comments and suggestions together with truth data of nitrogen and fiber contents in tealeaves. Also author would like to thank Mr. Eikichi Sasaki of Map Station Co. Ltd., for their contribution to create GIS system and ground based network camera system.

4. REFERENCES

[1] J.T.Compton, Red and photographic infrared linear combinations for monitoring vegetation, Journal of Remote Sensing of Environment, 8, 127-150, 1979.

[2] C.Wiegand, M.Shibayama, and Y.Yamagata, Spectral observation for estimating the growth and yield of rice, Journal of Crop Science, 58, 4, 673-683, 1989.

[3] K.Arai, Earth Observation Satellite Image Processing with Java Language, Morikita-shuppan Co.Ltd., 2000.

[4] S.Tsuchida, I.Sato, and S.Okada, BRDF measurement system for spatially unstable land surface-The measurement using spectral-radiometer and digital camera- Journal of Remote Sensing, 19, 4, 49-59, 1999.

[5] K.Arai, Lecture Note on Remote Sensing, Morikita-shuppan Co., Ltd., 2000.

[6] https://secure.logmein.com/welcome/access/freedom/3/?wt.srch=1&utpk=LogMeIn&destination=/welcome/access/freedom/3/&originid=38702&ef_id=TElbkAqoEEQAAChJc3oAAUDv:20110305090242:s

[7] P.Dutre, E.Lafortune, and Y.D. Willems. Monte carlo light tracing with direct computation of pixel intensities. In *Compugraphics '93*, pages 128-137, Alvor, Portugal, 1993.

[8] J.E. Greivenkamp, *Field Guide to Geometrical Optics*. SPIE Field Guides vol. FG01. SPIE. ISBN 0-8194-5294-7, 2004.

[9] R. Seto, H. Nakamura, F. Nanjo, Y. Hara, *Bioscience, Biotechnology, and Biochemistry,*Vol.61 issue9 1434-1439, 1997.

[10] M. Sano, M. Suzuki,T. Miyase, K. Yoshino, Maeda, M.Yamamoto, J.Agric.Food Chem., 47 (5), 1906-1910 1999.

INSTRUCTIONS TO CONTRIBUTORS

The *International Journal of Ubiquitous Computing (IJUC)* is devoted in assimilating publications that document development and research results within the broad spectrum of subfields in the engineering sciences. The journal intends to disseminate knowledge in the various disciplines of the Ubiquitous Computing field from theoretical, practical and analytical research to physical implications and theoretical or quantitative discussion intended for both academic and industrial progress.

Our intended audiences comprises of scientists, researchers, mathematicians, practicing engineers, among others working in Engineering and welcome them to exchange and share their expertise in their particular disciplines. We also encourage articles, interdisciplinary in nature. The realm of International Journal of Ubiquitous Computing (IJUC) extends, but not limited, to the following:

To build its International reputation, we are disseminating the publication information through Google Books, Google Scholar, Directory of Open Access Journals (DOAJ), Open J Gate, ScientificCommons, Docstoc and many more. Our International Editors are working on establishing ISI listing and a good impact factor for IJUC.

The initial efforts helped to shape the editorial policy and to sharpen the focus of the journal. Starting with volume 1, 2011, IJUC appears in more focused issues. Besides normal publications, IJUC intend to organized special issues on more focused topics. Each special issue will have a designated editor (editors) – either member of the editorial board or another recognized specialist in the respective field.

We are open to contributions, proposals for any topic as well as for editors and reviewers. We understand that it is through the effort of volunteers that CSC Journals continues to grow and flourish.

IJUC LIST OF TOPICS
The realm of International Journal of Ubiquitous Computing (IJUC) extends, but not limited, to the following:

- Access Control and Access Networks
- Ad Hoc Networking
- Ambient Intelligence
- Automated and Adapted Service
- Context Framework and Middleware
- Context Management
- Context Media Processing
- Context-aware Computing
- Context-Aware Systems (6 hours)
- Contexts & the Context-Aware Life-Cycle
- Embedded Software and Intelligence
- Everyday UbiCom Applications
- Intelligence Service Grid
- Intelligent Network
- Intelligent Sensor Network
- Intelligent Web Service
- location-Aware Application
- Management of UbiCom Systems
- Mobile Services
- Context Acquisition and Representation
- Context Adaptation Design
- Context Analysis and Utilization
- Context Database
- Mobile Services
- Mobility Dimensions & Design
- Open Service Architecture
- Real and Cyber World Semantics
- Security Management in Ubiquitous Computing
- Situated Service
- Smart Objects and Environments
- Spatial Awareness
- Technology Compositing
- Temporal Awareness & Composite Context Awareness
- UbiCom Environments & Smart Environments
- UbiCom System Properties for Smart Devices
- Ubiquitous Communication (10 hours)
- Ubiquitous Computing

CALL FOR PAPERS

Volume: 2- **Issue:** 1- February 2012

i. Paper Submission: November 30, 2011 **ii. Author Notification:** January 01, 2012

iii. Issue Publication: January / February 2012

CONTACT INFORMATION

Computer Science Journals Sdn BhD
B-5-8 Plaza Mont Kiara, Mont Kiara
50480, Kuala Lumpur, MALAYSIA
Phone: 006 03 6207 1607
006 03 2782 6991

Fax: 006 03 6207 1697

Email: cscpress@cscjournals.org

COMPUTER SCIENCE JOURNALS SDN BHD
M-3-19, PLAZA DAMAS
SRI HARTAMAS
50480, KUALA LUMPUR
MALAYSIA