Monitoring Temperature and Humidity Wireless Realtime-Based

by Asep Andang

ISBN : 978 – 602 – 70050 – 4 – 4

Integrated Sci-Tech

The Interdisciplinary Research Approach

VOLUME 3

IC-STAR 2017

The 3rd International Conference on Science, Technology, and Interdisciplinary Research 2017

Bandar Lampung, 18 - 20 September 2017

Integrated Sci-Tech : Interdisciplinary Research Approach

Volume 3

Publisher :

Research Institute and Community Services
University of Lampung

Integrated Sci-Tech : Interdisciplinary Research Approach
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ISBN :
978 – 602 – 70050 – 4 – 4

Editorial Board :

Cover and layout :

IC-STAR Team

Publisher :

Research Institute and Community Services
University of Lampung

Preface

The 3rd Volume of Integrated Sci-Tech: Interdisciplinary Research Approach book is published by the Research Institute and Community Services, University of Lampung. It integrates engineering, life sciences and biomedical engineering, and agriculture engineering and food sciences. The aim was to provide a cross section roadmap from basic research, technological and developments, processes development, and their applications and integrity in the real-world usage. The motivation for this Volume-3 book was to provide a suitable reference text for those who interested in the interdisciplinary studies and research. The book was also planned to provide advanced orientation and understanding for related industries and governments to looking across industrial partnerships, business strategic, and policy and regulations, with expected for a wider range of readers.

This book consists of several chapters divided into four sections i.e., Engineering and Technology, Life and Applied Sciences, Medical Sciences and Biomedical Engineering and alsoAgricultural Engineering and Food Science. Each chapter is a completely self-directed contribution in chained discussion which aims to bring academia, researcher, practitioners and students rise to speed with the novel developments within the particular area. In order to enhance the reader experience, each book chapter contains its own abstract, instruction, main body, as well as conclusion sections. Moreover, bibliography resources are available at the end of each chapter.

We are pleased and thankful for all distinguish authors and reviewers for their contribution that have made this book possible. We do hope that you will enjoy this book and find it as a useful guide and reference.

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Keynote and Invited Speaker

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Indonesia Supergrid : Enabler for 100% Renewable Energy

Pekik Argo Dahono[1,a]

[1] Institute Technology of Bandung, Indonesia
[a]dwi.gustiono@bppt.go.id

Abstract. *Moving toward renewable energy is a must rather an option. Indonesia has abundant renewable energy resources that enough to fulfill our demand on energy. Unfortunately, renewable energy resources are distributed unevenly and sometimes faraway from the load centers. In order to solve the problem, a concept of Indonesia supergrid is proposed. By using this supergrid, all renewable energy resources can be utilized effectively. By using supergrid, economic development can be distributed more evenly. The supergrid can be implemented by using AC or DC grids, or combination of the two. A simple concept of how to fund the construction of Indonesia Supergrid is proposed.*

Keywords: *supergrid, renewable energy*

Chemical Engineering Approach for the Design and Evaluation of Sound Material Cycle Network

Koichi Fujie[1,a]

[1] Institute of Advanced Sciences, Yokohama National University, Japan

[a]fujie@ynu.ac.jp

Abstract. *Chemical engineering concept and methodology were applied for the minimization of environmental load from industrial and agricultural processes, and our daily activities in the regional area. The results of material flow analysis on those processes and regional area are conveniently used to evaluate the materials input and the consumption, and thus the resource productivity as well as the environment loading. The results of material flow analysis and their evaluation were essential for the design and evaluation of sound material flow/recycle network. In this presentation, design and evaluation of biomass residue recycle system in the plantation and that of wastes recycle system in a regional material area will be illustratively shown based on material flow analysis. Through the presentation, it will be emphasized the importance of material and energy flow analyses to achieve the sustainable development goals with less consumption of resources and less environment loading while providing sufficient services to our daily life*

Keywords: *material cycle, waste management*

Sustainable Land Use Management for Mitigating Greenhouse Gas Emission

Muhajir Utomo[1,a]

[1] Faculty of Agricultural, University of Lampung, Indonesa
[a] mutomo2011@gmail.com

Abstract. *Food shortage and climate change due to greenhouse gas (GHG) emissions are currently receiving considerable attention worldwide. While most of the increase of global warming is due to CO2 from fossil fuel, in fact, land uses and agriculture globally account for around 30% of global warming. Difference compared to fossil fuel sectors, how ever, land uses including agriculture and forest have opportunity to mitigate GHG emission. The strategies are by implementing sustainable land use management practices such as (1) sustainable soil management, (2) carbon rich farming, (3) perennial/agroforest farming, (4) sustainable grassland management, and (5) sustainable forest management. The objectives of this paper are to revieuw the influence of some sustainable land use managements on CO2 emission, C stock and C sequestration. From long-term no-tillage (NT) research (29 years of cropping), it revealed that cumulative CO2 emission of conventional tillage (CT) was 2.0 ton CO2-C/ha/season, minimum tillage (MT) was 1.5 ton CO2-C/ha/season and NT was 1.0 ton CO2-C/ha/season. Soil C stock under NT corn at 0-20 cm depth was 34,03 ton C/ha, or 11.1% higher than CT. Soil C sequestration rate by NT was the highest, that was 118.4 kg C/ha/yr; while in contrast, soil C sequestration under CT was the lowest (-20.7 kg C ha-1yr-1). In soil profile, C stock under NT corn in upper horizon was higher than CT, but decreased with depth. In 5 years of sugarcane research, it turned out that after 5 years of treatment applications, NT had significantly stored 39.82 ton C/ha, or 23.7% higher than CT. While mulching with 150 ton bagasse/ha had stored 38.91 ton C/ha, or 17.6% higher than without mulching. Soil C sequestration rate under NT sugarcane was 2.40 Mg C/ha/year, while in CT was only 0.81 Mg C/ha/year. Mean while, bagasse mulch with 150 ton/ha contributed 2.07 ton C/ha/year, and treatment with no mulch contributed 1.15 tonC/ha /year. In peatland, emission of CO2 average of three years of measurements (2011-2013) from Acacia (Ac) was the highest among land uses (59 ton CO2/ha/yr); while CO2 emissions from mixed forest (Mf), and tall forest (Tf) were 28, and 27 ton CO2/ha/yr, respectively. Compared to business as usual value, the CO2 emission from Ac was 44% lower, but still 5% higher than that of bare peatland. The carbon sequestration of Ac biomass was equal to 97 ton CO2/ha/yr. As a green campus, University of Lampung also sequestered above ground C as much as 35.5 ton C/ha or 2000 ton C/total area.*

Keywords*: Carbon stock and sequestration, sustainable land use management*

Development of Porous Hydroxyapatite Biomaterials for Bone-Graft Substitute

Dwi Gustiono[1,a], Agus Hadi Santosa Wargadipura[1], Mochammad Dachyar Effendi[1], Seto Roseno[1], Nendar Herdianto[1], Ferdiansyah Mahyudin[2]

[1] Centre for Materials Technology, Agency for Assessment and Application of Technology, Gedung 224 Puspitek Tangerang Selatan, Banten, Indonesia
[2] Biomaterials Centre and Tissue Bank, Dr Soetomo Hospital, Airlangga University, Surabaya, Indonesia
[a]dwi.gustiono@bppt.go.id

Abstract. *Hydroxyapatite is the main constituent material of bone and teeth. In this paper, a hydroxyapatite powder material was made from local limestone with a simple chemical method. The porous hydroxyapatite material is prepared by replica techniques using polymer sponges. The characterization of this hydroxyapatite material is carried out by chemical, physical and biological methods. The results of analysis using FTIR and XRD equipment showed that the hydroxyapatite characteristics are similar to natural ones. The result of measurement with TEM equipment shows that the invisible particles of this hydroxyapatite powder have a rod-like shape and are about 30 - 60 nm in size. The porous hydroxyapatite materials made with replica techniques revealed a pore size of about 200-500 µm and had good interconnections as determinate by SEM measurements. Biological test results in rabbit animals show that the implantation of this hydroxyapatite material can stimulate bone growth faster than if it is allowed to grow alone (control). Bone ingrowth was significantly increasing over the time between 3 and 6 weeks.*

Keywords: *porous hydroxyapatite, bone graft, polymer sponges, limestone.*

Biomechanical Tuning of Biomaterials, Extracellular Matrix, and Culture Model to Engineer the Angiogenesis and Microvascular Development

Irza Sukmana[1,a]
[1]Department of Mechanical Engineering, Faculty of Engineering, University of Lampung, Gedung H, Lt. 2;
*[a] irza.sukmana@eng.unila.ac.id

Abstract. *The guidance of human endothelial cell (HEC) organization into a newly capillary-like network from the pre-existing ones (i.e., angiogenesis) has been a long standing challenge in the development of thick engineering tissue and artificial organ. Some efforts have been made to develop biomaterial, extracellular matrix environment and specific culture model for the promotion of capillary-like structure inside the engineering scaffold and artificial tissue constructs. Capillary-like structure and micro-vascular networks would mimic blood vessel function that can be used to subsequently facilitate oxygen and nutrient transport as well as biological waste removal inside the artificial tissue and organ system. Vascularization of engineering tissue is one of the most favorable strategies to overpass nutrient and oxygen supply limitation, which is often the major hurdle in developing a complete artificial organ. This paper aims to highlight the mechanical and biophysical properties of biomaterial, extracellular matrix and cell culture model for the purpose of angiogenesis and micro-vascular development studies. The recent in vitro investigation of Human Endothelial Cells (HECs) in a three-dimensional (3D) culture system for the guidance of HUVEC's angiogenesis development is also presented..*

Keywords: *biomechanical tuning, angiogenesis development, three-dimensional culture, endothelial cells.*

Synthesis and Characterization of Hydroxyapatitematerial Performed from Indonesian Limestone by Precipitation Method

Sudirman Habibie[1,a], Nendar Herdianto[1],Muslim E. Harahap,Diah Ayu Fitriani[1], Lukmana[1], Stephen Clarke[2]

[1]Center of Technology forMaterial, Agency for the Assessment and Application of Technology,
[2]24th Building, Puspiptek Area, Serpong, South Tangerang – Banten 15314, Indonesia
[2]AdvancedMaterial Solutions, Australia
[a]sudirmanhabibie@yahoo.com

Abstract. *Limestone which is one of the raw materials for the manufacture of materials and medical devices obtained scattered in almost all provinces in Indonesia. In this paper, synthesis of hydroxyapatite using limestone as the raw material was studied. Synthesis of hydroxyapatite was done using precipitation method. The main material of forming a hydroxyapatite in this study is diammonium hydrogen phosphate and calcination of limestone at 9000C for 4 hours that produce calcium oxide (CaO). The pure calcium oxide was observed in order to know the effect of calcium solution addition rate and calcium precursor size. The calcium oxide precursor was prepared wit h high energy milling (HEM). HEM usage is intended to produce a precursor size of calcium in nano size. Furthermore, the characterization of second phase precursors using x-ray diffraction (XRD), analysis of morphology and element content using scanning electron microscopy-energy dispersive X-ray (SEM-EDX) and analyzes the size and distribution of particles of calcium resulted from milling using a particle size analyzer (PSA).*

Keywords: *Limestone, hydroxyapatite, precipitation method, x-ray diffraction, SEM-EDX, particle size analyzer*.

Section I

Engineering and Technology

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Monitoring Temperature and Humidity Wireless Realtime-Based LabVIEW (#591)

Asep Andang[1,a], Nurul Hiron[1,b]
[1]Electrical Engineering Departement, Universitas Siliwangi
[a]andhangs@unsil.ac.id, [b]hiron@unsil.ac.id

Abstract. *In this study, the temperature monitoring system used was the MyRIO with LabVIEW-based programming. LabVIEW-based programming is known for its versatility and ease of access to the hardware and internet technology. The instrument used was the DHT11 sensor to communicate with MyRIO, whereas to bridge the communication between MyRIO and CPU wireless communication was used. Then, the captured results were displayed on the CPU by using IEEE 802.11 Protocols. Based on the tests conducted on 10 experimental conditions, it was known that the DHT11 temperature sensor resulted in a 1.99% error rate. This value indicated the acceptable accuracy that is below 5% while the error rates of the humidity measurement varied, i.e. in the 5th to the 10th test conditions in which the acquired error rates enlarged up to 13.5%. This meant that humidity sensor accuracy had good accuracy in the 1st to the 4th testing conditions.*

Keywords **:** *DHT 11, LabVIEW, MyRIO, temperature, humidity*

I. Introduction

The observation system or remote monitoring currently has undergone very rapid developments, one of which is in measuring the monitoring system of new and renewable energy parameters. Various systems have been proposed with various methods, both in processing and in the process of data transmission, as well as data communication systems which are experiencing rapid development. With the standard protocol IEEE 802.11, communications between processor sensor to the collector become easier, one of which by using the zigbee protocol combined with an arduino with real-time monitoring system [1] which generates data in accordance with the data in the field, while the data transmission system with batching methods [2] generate compressed data per day which are sent and collected in the memory of the arduino sent per day as well. The use of zigbee protocols in a standalone process also used in monitoring the weather [3] at the lab scale by using LM 35 as well as DHT 11.

The combination of Zigbee Protocol and data transmission communications from sensors to hosts or to servers is performed by incorporating GSM technology [4], by using a GSM Modem and TCP/IP protocol the data is sent, generating considerable distance in accordance with GSM modem capabilities. Another system used in weather monitoring is a radio frequency (RF)[5] using the module 1020U-Kyl as a delivery medium.

The research conducted using this platform either incorporated the arduino or Zigbee and LabVIEW interface generated output in the form of MS Excel[6] using the sensor SHT 11 with communications systems that were quite different from others in order to connect to an arduino. Other studies using LIFA facilities (LABVIEW Interface For the Arduino)[7] although the sensor used was still LM35. In another study [8] the integration was performed on software ie Labview as the interface and KEIL software by using LM35 as the temperature sensor.

The integration of the above-mentioned systems was performed in order to use a sensor that has a communication pattern with other systems. LM35 temperature sensor output has an analog output with the increase rate of the current of 100mV/°C, the sensor can be directly accessed by LABVIEW, unlike SHT 11 or DHT 11 which uses single wire interface that needs a bit different handling.

DHT11 sensor, which had the sufficient capability, was used in the system that was being built. The form of DHT11 can be seen in Figure 1 below

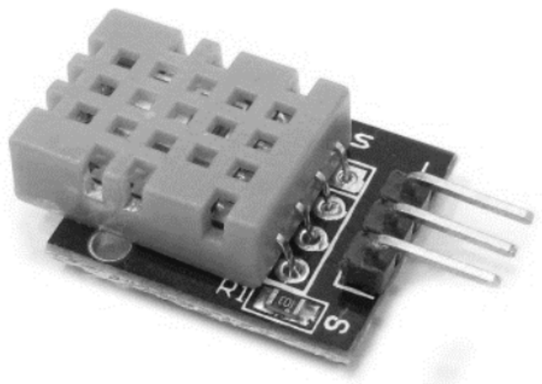

Figure 1. DHT11 Temperature and Humidity sensor

This DHT sensor has a quite unique communication with the transmitted data of 40 bits with the accuracy of ± 4% RH and resolution temperature of 1°C. Make this sensor is quite sought after and used in various temperature and humidity metering systems.

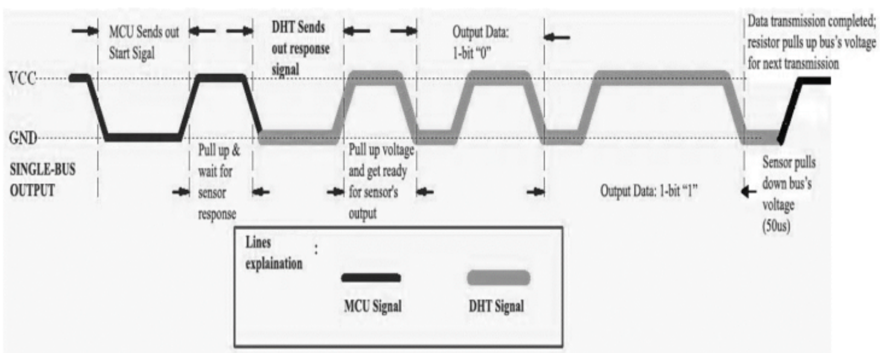

Figure 2. DHT11 Communication Process

Figure 2 shows the DHT11 working process which depends on the MCU signal. When the signal goes into the sensor, the DHT will be turned into running-mode, and then send a 40 bits signal including the humidity and temperature data. In the absence of signals from the MCU, DHT11 will not give the input signal [9].

As for the MCU, MyRIO, which is the product of National Instrument, was used. It has Z-7010 Xilinx processors with a speed of 667 MHz and has a non-volatile memory of 256 MB and 512 MB DDR memory. While for communication, MyRIO has wireless connection IEEE 802.11 b, n with 2.4 GHz frequency band with 20 MHz channel depth, MyRIO is equipped with Digital I/O and Analog I/O with 12-bit resolution.

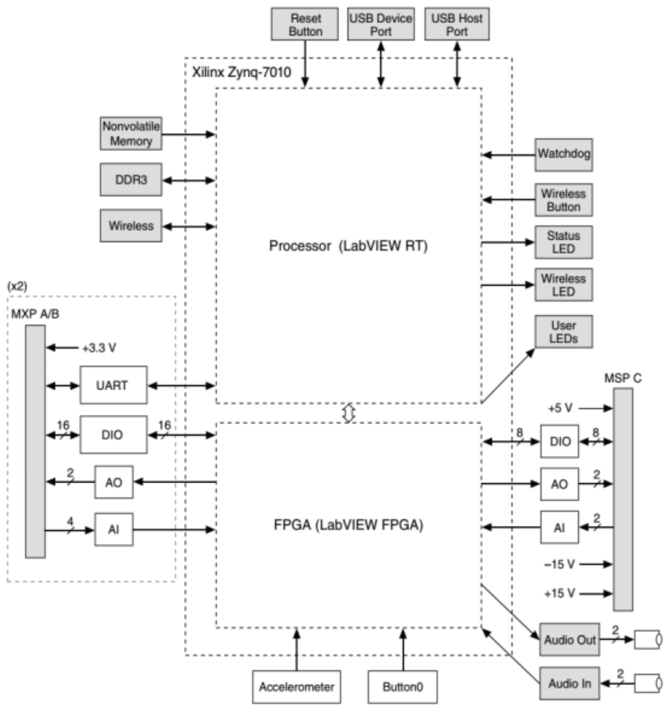

Figure 3. MyRIO 1900 Diagram Block

II. Procedure

A. System Plan

The developed system consisted of 2 parts namely, system sensor and MCU consisting of temperature and humidity sensor as well as the MCU in the form of MyRIO 1900, and also a recipient that is CPU. The communication between MyRIO 1900 and the CPU was performed by using IEEE 802.11b network with 2.4 GHz working frequency. In this developed system, the access point used in MyRIO presents on the system itself without external reinforcement.

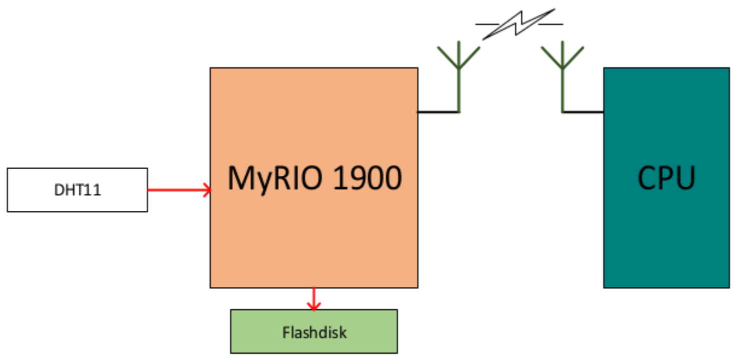

Figure 4. Block Diagram of Temperature and Humidity Monitoring Hardware

The mechanism of the block diagram can be seen in the flowchart below, the first process was the initialization program that would prepare the necessary things for processing temperature and humidity data. Figure 5 is a flow diagram of the system.

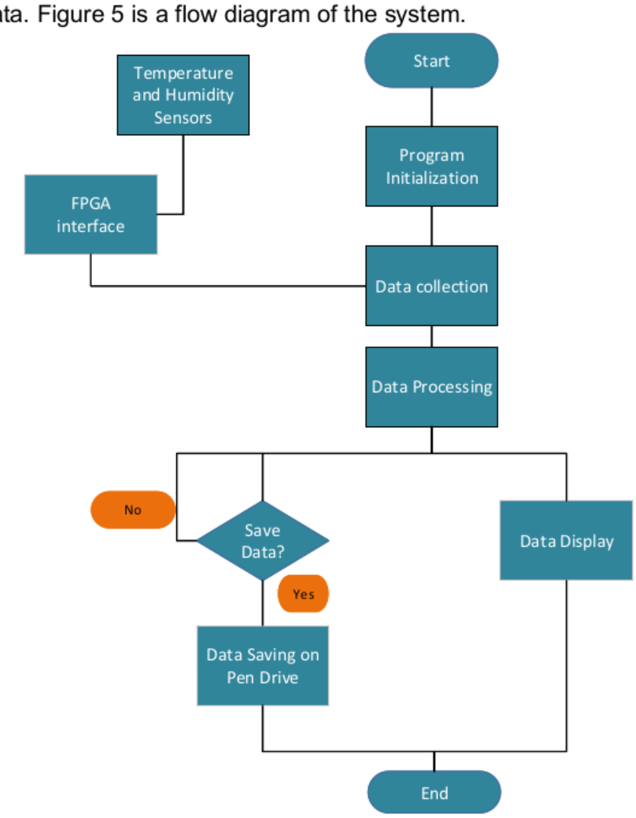

Figure 5. Flowchart

This data was then processed to be displayed in graphical form in real time and stored in the form of excel. As for storage media, a Pendrive, which was connected with MyRIO, was used. However, this data still could be accessed from the CPU.

The following figure shows what was displayed in the settings panel which was the front panel of the LabVIEW system. This view was accessed from the CPU using wireless 2.4 GHz consisted of a graphics display, storage options, and other settings.

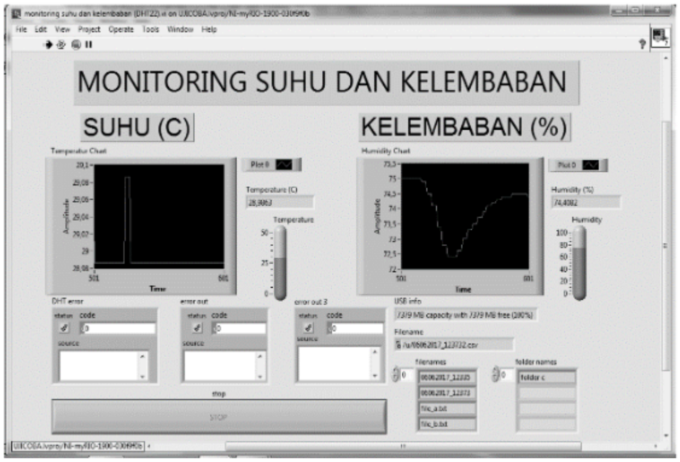

Figure 6. LabVIEW Front Panel

B. Result

In order to get the results, then a series of tests was performed by comparing the DHT11 sensor with a measuring instrument so that two data that could be displayed in graphical form. The series of tests performed is shown in the picture below.

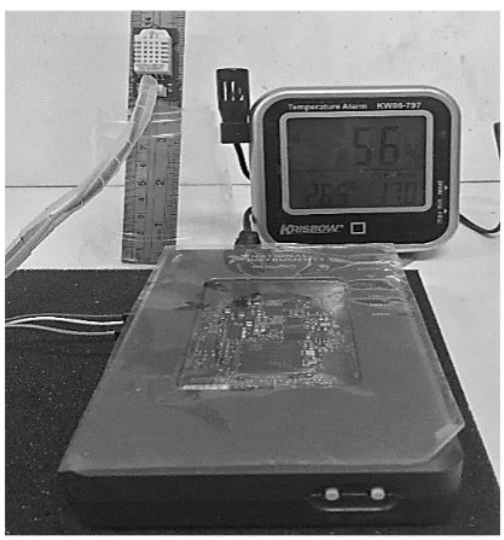

Figure 7. System Testing

With a series like the one above, the test was performed with varying temperature and humidity resulting in the graph which is a comparison of the measuring instrument.

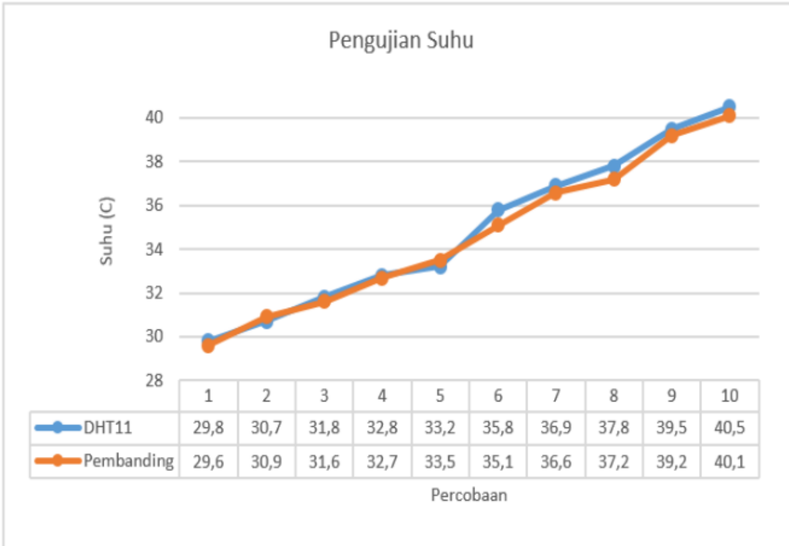

Fig 8. Temperatur Testing

The test was carried out at the lowest temperature of 29.6°C and the highest one was 40.1°C. As can be seen the temperature rate was rising. Based on the calculation, the smallest error difference was 0.31% and the largest difference error was 1.99% so there was an error range of ± 1.5%.

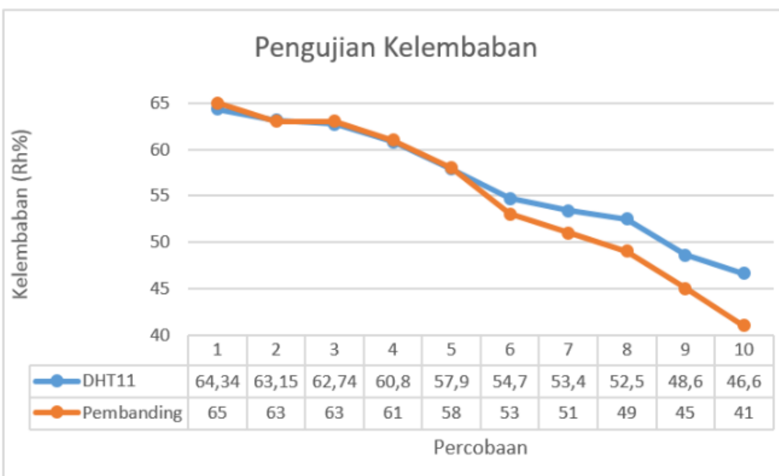

Figure 9. Humidity Testing

Meanwhile, in humidity testing, there were differences of error as the shown in the graph below. The test was carried out in humidity range 65% to 41%, the minimum error was 0.17% and maximum error was 13.66%, so the range of error was about ± 13, 50%.

The use of LabVIEW with MyRIO Hardware simplified the tools configuration used for the connection both between MyRIO and the sensor and between MyRio and the computer to display measurement results and data storage. The use of wireless communication with the IEEE 802.11 protocol b, g, n facilitated communication link.

The test results could be accessed by using the webpage as shown below

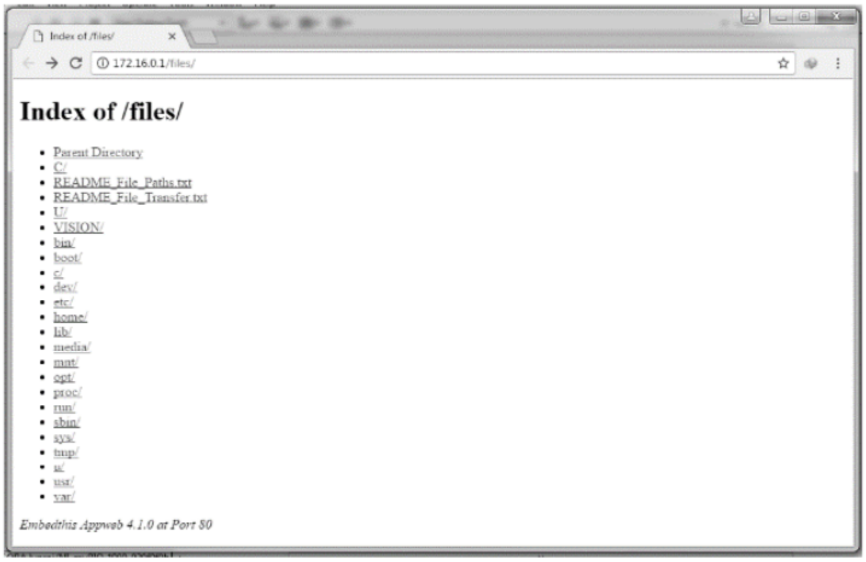

Figure 10. Data acces using MyRIO wifi

which will generate the CSV data in accordance with the desired sampling time.

III. Conclusions

Temperature and humidity monitoring systems using LabVIEW and MCU MyRIO and DHT11 sensor managed to sense temperature and humidity even though DHT11 used/equipped with (dilengkapi) a rare-use single-wire interface. This could be overcome by using the FPGA interface so that the data communications could be stored and displayed with adjustable sampling rates.

The results obtained from the humidity and temperature test which was performed by using DHT 22 sensor resulted in test error rate under 5% that is, at the smallest rates, 0.31% and 1.99%. Whereas, for the humidity, there was the biggest error i.e. 13.5%. One of the things which led to the existence of a fairly large error was the construction of DHT which had a hollow. It could cause humidity, especially because water still clung to the hollow.

The test resulted in a comparison between the DHT11 sensor with other test equipment. Although the measurement range was not so wide but still able to know the performance of the system created, this can be seen based on the number of experiments. Meanwhile, the error in the temperature test was fairly good.

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