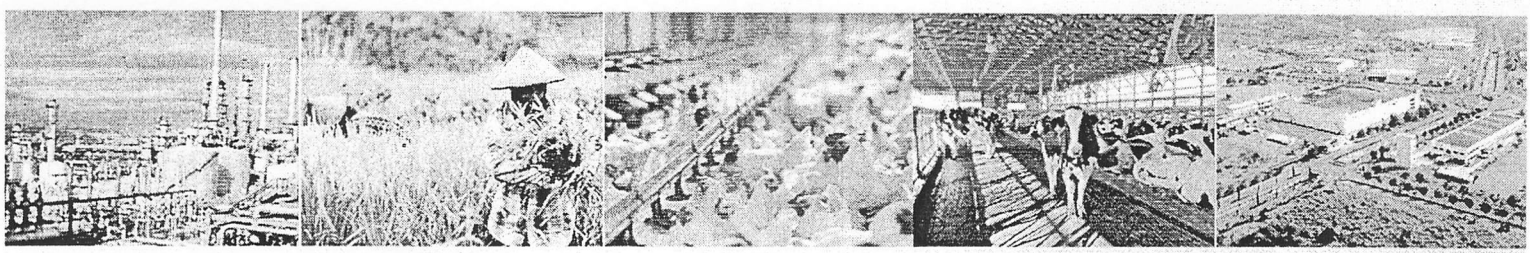
PROCEEDINGS

2015 3rd International Conference on Adaptive and Intelligent Agroindustry (ICAIA)

ICAIA 2015



August 3rd - 4th, 2015
IPB International Convention Center
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Bogor Agricultural University

Bogor, Indonesia

Welcome Message from The General Chairs of ICAIA 2015

On behalf of the organizing committee, it is our pleasure to welcome you to International Conference on Adaptive and Intelligent Agroindustry, Bogor, Indonesia. This is the 3rd conference on the topic that is held by the Department of Agroindustrial Technology, Bogor Agricultural University, Indonesia.

The conference is expected to provide excellent opportunity to meet experts, to exchange information, and to strengthen the collaboration among researchers, engineers, and scholars from academia, government, and industry. In addition, the conference committee invited five renowned keynote speakers, i.e. Prof Irawadi from Bogor Agricultural University; Prof Kenneth De Jong from George Mason University, USA; Dr Yandra Arkeman from Bogor Agricultural University; and Dr Guillermo Baigorria from University of Nebraska-Lincoln, USA.

The conference committee also invited Prof Noel Lindsay from University of Adelaide, Australia; Kiyotada Hayashi from National Agricultural Research Center-Tsukuba, Japan; Prof Margareth Gfrerer from Islamic State University of Jakarta, Indonesia; Dr Barry Elsey from University of Adelaide, Australia; Dr Gajendran Kandasamy from Melbourne University, Autralia; and Imperial College London-British, Prof Allan O'Connor from University of Adelaide, Australia; Dr Wisnu Ananta Kusuma from Bogor Agricultural University ,Indonesia; and Dr Frank Neumann from University of Adelaide, Australia, as invited speakers.

This conference was organized by Department of Agroindustrial Technology, Bogor Agricultural University and Asosiasi Agroindustri Indonesia, and technically sponsored by IEEE Indonesia Section. Furthermore, it was supported by Departement of Computer Science, Bogor Agricultural University; Surfactant amd Bionegergy Research Center; PT Bogor Life Science and Technology; Indonesian Ministry of Industry; PT Pachira Distrinusa; and PT Kelola Mina Laut.

I would like to take this opportunity to express my deep appreciation to the conference's committee members for their hard work and contribution throughout this conference. I would like to thank authors, reviewers, speakers, and session chairs for their support to participate in the Conference. Lastly, I would like to welcome you to join ICAIA 2015 and wish you all an enjoyable stay in Bogor.

Sincerely,
Dr Yandra Arkeman
General Chairs, ICAIA 2015

WELCOMING ADDRESS

Prof. Dr. Ir. Nastiti Siswi Indrasti
Head of Agroindustrial Technology Department
Faculty of Agricultural Engineering and Technology
Bogor Agricultural University
on
3rdInternational Conference on Adaptive and Intelligence Agroindustry (3rd ICAIA)
Bogor, August, 3 – 4, 2015

Assalamu'alaikum Warohmatullahi Wabarokatuh
In the name of Allah, the beneficent and the merciful,

Distinguish Guest, Ladies and Gentlemen
Let me first thank you all for accepting the invitation to participate in this 3rd International Conference on Adaptive and Intelligence Agroindustry (ICAIA). In particular I would like to thank Rector of IPB (Institut Pertanian Bogor/Bogor Agricultural University) Prof. Herry Suhardiyanto for supporting this event as part of the series academic event in celebrating the 52nd Anniversary of Bogor Agricultural University.

We are certainly proud to have been able to assemble this event in IPB, Bogor. The range of participants and audience at this conference is precisely something I would like to stress. Participants who followed the event more than 150 people, coming from various countries including the USA, Australia, Japan, Vietnam, Philippine, Germany and Indonesia. The main goal of the conference is to provide an effective forum for distinguished speakers, academicians, professional and practitioners coming from universities, research institutions, government agencies and industries to share or exchange their ideas, experience and recent progress in Adaptive and Intelligent Agroindustry.

The 2015 3rd International Conference on Adaptive and Intelligent Agro-industry (ICAIA) is the third forum for the presentation of new advances and research results on various topics in all aspects of innovative agro-industry that highlights the development and improvement for today and tomorrow's global need for food, energy, water and medicine. The aim of the conference is to stimulate interaction and cohesiveness among researchers in the vast areas of innovative agro-industry. Innovative Agro-industry has the ability to adapt intelligently to future global challenges, i.e. food, energy, water, and medical. Global challenges needs a new breed of Agroindustry which could produce innovative products to fulfill the needs through advanced processing technology, production systems and business strategy supported by cutting-edge information and communication technology.

The topic for this event is "Empowering Innovative Agroindustry for Natural Resources, Bioenergy and Food Sovereignty". The topics clustered into four main parts:
Track 1 : Innovative Agroindustrial and Business System Engineering

Track 2 : Frontier Approaches in Process and Bioprocess Engineering
Track 3 : Frontier Approaches in Industrial Environmental Engineering
Track 4 : Intelligent Information and Communication Technology for Adaptive Agroindustry of the Future

This event also hosts four (4) workshops: (1) Strategies for Agroindustry Development (2) LCA for Agroindustry (3) Innovation and Technopreneurship for Agroindustry and (4) Agroindustry Informatics.

Distinguish Guest, Ladies and Gentlement,
Agroindustry transforms agricultural commodities into high value-added products. Agroindustry is industry that process agricultural products to increase their value added significantly by using technology and by considering environmental aspect and sustainability. However, with changing global demand and technology advancement, innovative agroindustry is needed in order to be competitive as well as sustainable. The challenge of future agroindustry is not merely efficiency and productivity anymore, but also the challenge to appropriately apply frontier technology as well as meeting future global demands.

Agroindustry needs to deal with the application of advance technologies and cope future global issues. Current global issues which arise and expected to exist in the future are food sovereignty, renewable energy, sustainable water management and pharmacy. The ability of agro-industry to respond the future global issues and the undoubtedly substantial increase in demand in future decades will be highly dependent on the increased application of existing technologies as well as the exploitation of new and innovative technologies.

The emergence of high technology could be applied in the agro-industry are: nanotechnology, biotechnology, bioinformatics, food processing, food packaging-waste, state-of-the-art computation and many others. The aforementioned high-technology along with computation technology could greatly advance agro-industry from a traditional system into a smart-intelligent and innovative technology. Therefore, in the new millennia, adaptive-intelligent and innovative agro-industry will contribute to solutions to global problems and brings agriculture into perfection.

Hope this conference will also discuss this issue in more detail as it is an important matter for all of us. We should no more think just how to produce high value product but it is also necessarily important how to keep our live in good quality by understanding following old saying... "You do not live at once. You only die once and live every day".

I do not to take up any more of your time with these opening remarks. Let me simply thank you once again for sharing your thoughts with us. Here's wishing every success for the conference. May Allah bless all of us.

Thank you for your kind attention,
Wassalamu'alaikum Warohmatullahi Wabarokatuh

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AGENDA

Time	Activities
Monday, August 3rd 2015	
08.00 - 09.00	Registration
09.00 - 10.00	Opening Ceremony • Welcoming Address: Prof. Nastiti Siswi Indrasti (Head of DAT, Fateta, IPB) • Welcoming Speech Head of Bogor Regency • Conference Opening: Prof. Herry Suhardiyanto (Rector of IPB) • Opening Speech and Conference Opening : Minister of Industry Indonesia * • Launching Expose International program DAT
10.00 – 10.05	*Photo Session*
10.05 - 10.15	*Coffee break*
10.15 - 10.45 10. 45 - 11.30 11.30 – 12.00 12.00 – 12.30	Keynote Speech : 1. Prof Irawadi (Bogor Agricultural University, Indonesia) 2. Prof. Kenneth De Jong (George Mason University, USA) 3. Dr. Yandra Arkeman (Bogor Agricultural University, Indonesia) 4. Dr. Guillermo Baigorria (University of Nebraska, Lincoln, USA)
12.30 – 13.30	Lunch break
13.30 – 13.50 13.50 – 14.10 14.10 – 14.30 14.30 – 14.50 14.50 – 15.10 15.10 – 15.45	Plenary Session 1 : Prof. Noel Lindsay (University of Adelaide, Australia) Dr. Kiyotada Hayashi (National Agricultural Research Center, Tsukuba, Japan) Prof. Margareth Gfrerer (Islamic State University of Jakarta, Indonesia) Dr. Barry Elsey (University of Adelaide, Australia) Ir. M. Novi Saputra (Marketing Director KML Food Group) *Discussion*
15.30 – 15.45	*Coffee break*
15.45 – 18.00	Parallel session A, B and C
18.00 – 21.00	Welcome Dinner

Time	Activities
Tuesday, August 4rd 2015	
08.30 – 09.00	Registration
09.00 – 09.20	Plenary Session 2 : Dr. Gajendran Kandasamy (PhD in Physic, Melbourne University ; PhD in Innovation Imperial Collage, London)
09.20 – 09.40	Prof. Allan O'Connor (University of Adelaide, Australia)
09.40 – 10.00	Dr. Eng. Wisnu Ananta Kusuma, ST, MT (Bogor Agricultural University, Indonesia)
10.00 – 10.20	Dr. Frank Neumann (University of Adelaide, Australia)
10.20 – 10.45	*Discussion*
10.45 – 13.00	Parallel Session A, B and C
13.00 – 14.00	Lunch break
14.00 – 15.30	Parallel Workshop • Strategies for Agroindustry Development • LCA for Agroindustry • Innovation and Technopreneurship for Agroindustry • Agroindustrial Informatics
15.30 – 15.45	Coffee Break
15.45 – 16.15	Closing remark

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Arduino-Based Temperature Monitoring Device for Cold Chain Transportation

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Abstract— **The aim of this study is to build a system and device prototype to monitoring temperature of cold chain transportation. The device use Arduino open source microcontroller platform as the basis. The data of the temperature stored inside SD card as a log file to report the temperature history during transportation. The device will transmit warning to drivers and related stakeholders. Warning activity occurred if the fluctuation of the container temperature reach or exceed temperature upper threshold. When the warning activity occurred, the device that connected through GSM network will send notification message to the related stakeholders and turn on warning lamp inside driver's cockpit. Several performance tests were done, including basic feature test, recording test, and transportation simulation test. The advantages of this device are open source, easy to modify and duplicate, inexpensive, easy to save the log files, and responsive. The disadvantages of this device are needed power supply and GSM network signal.**
Keyword: microcontroller, Arduino, temperature monitoring, cold chain transportation

I. INTRODUCTION

Nowadays, frozen food consumption plays an important role in modern society. Frozen food allows people to get food in good quality that is maintained in the low temperature storage. This trend will lead to the demand and the great need for frozen food products in the future. However, problems arise as a result of the nature of frozen products stored and distributed to the consumer with the cold chain system, which in case of errors in each aspect can make defective products [1].

To ensure the quality of the frozen product then all the processes that take place and the tools used must be ensured to work well. The quality of agriculture product is influenced by several factors, among others, post-harvest treatment (cooling, heating), humidity, packaging and others. The main idea of cold storage is by storing the commodity at a low temperature, so the process of respiration and senescence is delayed, and in the end can extend the shelf life of the commodity [2]. Spiess [3] also stated that the lowering the temperature of the product is one of the gentlest measures that can be used to retard food life spoilage and be able to reduce the metabolic activity of microorganisms.

Specifically, supply chain or logistics network is a system of organizations, people, technology, information, and resources involved in moving a product or service from producer to consumer [1]. Cold chain is a supply chain with controlled temperature, which a concept is born from the specific requirements related to the distribution of products that are sensitive to changes in temperature using refrigerated transport. Heap [4] stated that refrigerated transport of cold products is related to the displacement operation of the cold product from one storage area to another. The scope of refrigerated transport is very wide, depending on the needs. In the simplest example, refrigerated transport can be insulated ice box, and the most complex can be intermodal freight container with integral refrigeration machinery [4].

The highest potential for quality losses are happens after the storage transportation. It means that cold chain distribution and transportation have a high risk of quality losses. Maintain storage temperature is a key factor to prevent a variety of risks that can affect the safety and quality of food [5].Wright [6] stated that, the best way to assure that a product will be safe and of an acceptable quality when consumed is to control the temperature during storage and distribution and to integrate the temperature exposure over time.

Monitoring the temperature during distribution has become a very important issue in recent years. Several different technologies that can be applied to

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other recording storage temperature between chart recorders, time-temperature indicator (TTI), a label with the color change, and the data logger [1].

The aim of this work was to develop a system and device prototype to monitor the temperature during cold chain transportation with Arduino software and hardware. It was generate a possibility to connect the device through the GSM network so the device can send the warning and notification of the temperature history during transportation to the related stakeholder, either the producer, trucking service, or retailer. Thus the devices could act as quality assurance of cold product through the temperature monitoring of the product during cold chain transportation.

II. MATERIALS AND METHODS

2.1. Materials

In this research used open source hardware and software platform, DFRduino Uno R3 as microcontroller platform. It was also used Grove High Temperature Sensor (HTS) as an input to read the room temperature. The Grove-Temperature Sensor using a K-type thermocouple sensor. The detectable range of this sensor is -50-600 °C.

Type of shields used in this research was SD card Shield and GSM/GPRS shield. SD Card shield was SeedStudio 4th generation SD card shield, which have I2C and UART port already attached on the shield. GSM/GPRS shield used in this research is IComSat v 1.1-SIM 900 that also serves as a RTC (real time clock) module and is critical to the temperature data recording activity.

2.2. Method

Methodology used in this research consists of three steps: system and software design, hardware design and prototyping.

2.2.1. System Design and Implementation

This part was focused to define the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. Implementation of the system design in this research used Arduino IDE (Integrated Development Environment), a development platform for Arduino microcontroller with C based language. Relationship between each component function shown in Figure 1 below

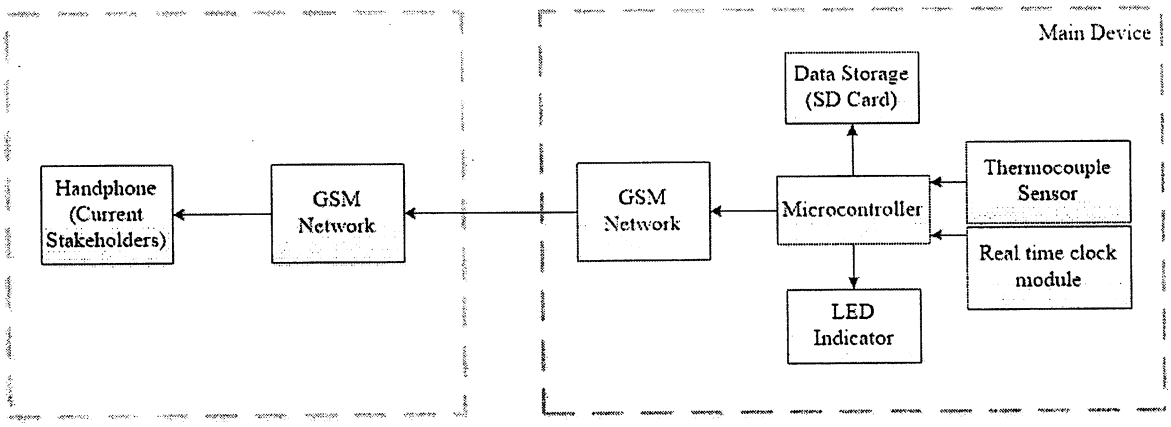

Figure 1 System architecture diagram

The output generated by the microcontroller is a log file that is saved to the storage media (SD card) in a .csv format that consists of temperature data and time. The log file (.csv file) can be opened using Microsoft Excel software. Other outputs are LED lights as cold container temperature indicator, and short message notification send through GSM network connected to the GSM shield as data flow diagram shown in below in Figure 2.

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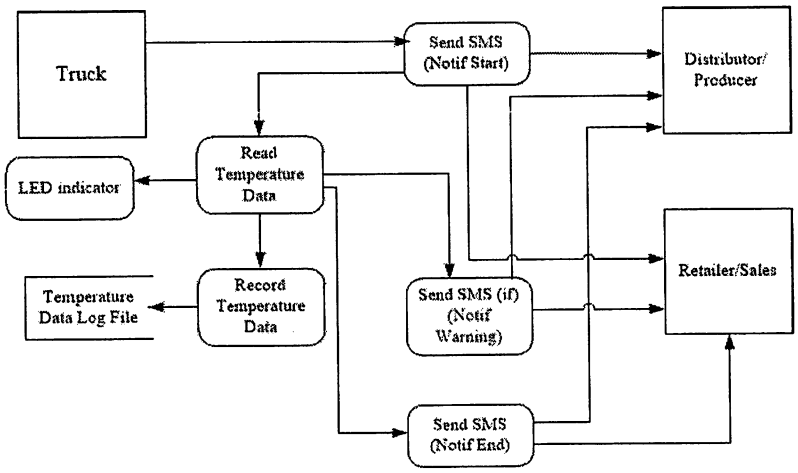

Figure 2 Data flow diagram

2.2.2. Hardware and Prototype Design

Hardware and prototype design begins with list of hardware needed based on the needs of system design. All hardware used in this research using the stackable shield component, so all additional components (sensors, modules, etc.) can be directly stacked on top of pins on the microcontroller and the other shield. Prototype design is done by uploading the program code from Arduino IDE to the microcontroller

III. RESULT AND DISCUSSION

3.1. System Design and Implementation

As illustrated in the system architecture diagram, the main device consists of thermocouple sensor, real time clock module, microcontroller, data storage (SD card), and LED indicator, connected to GSM network through short message service (SMS).

Microcontroller acts as the main control device that receives input and process to produce output. Input received to the microcontroller comes from thermocouple temperature sensor (Grove Temperature Sensor) which uses the ambient temperature as input data. The temperature sensor is the main input regarding the main function of this device as temperature recorder during the cold chain transportation. In addition to temperature sensor, other input is derived from the input time from real time clock (RTC) module which already attached into IComSat GSM / GPRS shield. RTC functions to produce time data, which is useful when the data logging process takes place by recording the temperature and time data simultaneously and continue, to generate the log data of temperature exposure over time. Device workflow diagram was shown in Figure 3 below.

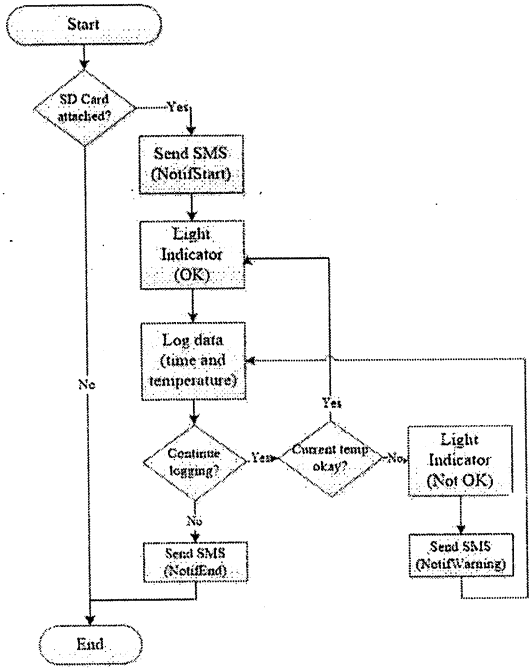

Figure 3 Device workflow diagram

Notification message received by the relevant stakeholders will be sent when important events occur when the transport takes place, such as, when it started to transport (start logging), when temperature rises above the maximum temperature threshold (warning notification), and when arrive at the destination (end logging). This notification serves as an event log that will be the secondary log event other than the log files recorded on the SD card. Log files recorded on the SD card will be accessed and saved as a complete transport records and can be used as an archive for all relevant stakeholders, while event logs sent via SMS will be quick report. An example of the usefulness of this quick

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report is can give warning when the temperature rises above the threshold, so that stakeholders can contact the truck to ask whether there is any problem with the truck refrigeration equipment.

Stakeholders who receive event log messages depend on the supply chain schemes undertaken by the company. If the company acts as a producer and distributor as well of its products to the retail (sales), then only the producer and retailer who act as receivers of the message. If producer do the distribution functions through third party (distribution company) before being handed over to the retailer, then the three parties, producer, distributor (3rd party), and the retailer becomes stakeholder and event log receiver.

If the current temperature exceeds the threshold then yellow indicator light turned on and notification message sent to stakeholders. Notification message contained information that there was a rise in container temperature exceeds the temperature upper threshold at that time. The device workflow could terminate when the transportation finished and the materials handed to other stakeholder.

The system design applied into a program computer. A computer program is a coded series of instructions that tells the computers what to do. The programs that run on Arduino are called sketches [7] and the software use to write the instruction code for Arduino is Arduino IDE (Integrated Development Program). Arduino IDE can be downloaded free from http://arduino.cc/en/Main/Software. The screen shot of the program can be seen in Figure 4.

Figure 4 Screen shoot of Arduino IDE software

3.2. Hardware and Prototype Design

Arduino shield used as component connected to Arduino microcontroller can be stacked above another component and does not required jumper cable to connect and assemble the device. Shield has "male pins" at the bottom of their board which can plug into Arduino pin headers. Shield also has pin headers that can be connected with another shield. Protoytping done after all components were assembled. Device prototype was shown in Figure 5.

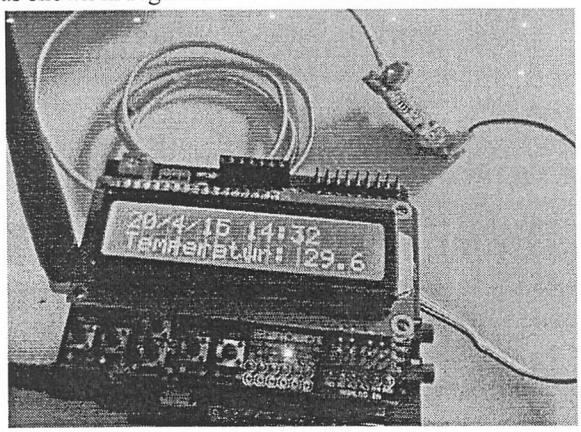

Figure 5 Device prototype

When the device turned on, it will run setup to process the program code uploaded to the microcontroller board. The device sends a notification for all stakeholders related (producers, distributors, retailer, etc.) that the transportation has started at that time, acquired from real time clock module (RTC). Log file (.csv format) created inside SD card to record the time and temperature during transportation every 5 minute. Log file example shown in Figure 6

Temperature Record Data Truck 093-TIN Expedition		
Date	Time	Temperature
1/6/2015	9:20	33.89
1/6/2015	9:25	35.05
1/6/2015	9:30	35.05
1/6/2015	9:35	33.89
1/6/2015	9:40	33.31
1/6/2015	9:45	33.41
1/6/2015	9:50	33.7
1/6/2015	9:55	33.41
1/6/2015	10:00	33.6

Figure 6 Recording log file example

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3.3. Advantage and Disadvantage

This device has several advantages and disadvantages. The advantages of this device are open source, easy to store log files, and have responsive warning activity feature. Arduino, an open source hardware and software makes this device inexpensive and easily duplicated and modified as needed with the addition of other sensors, such as pH sensor and humidity sensor. Log files can be archived easily on the computer because it is already stored in .csv file format.

Warning activity provide actual information about temperature inside the container to the driver and stakeholder related to the cold chain transportation. Stakeholders can immediately know about the events occurred during transportation takes place, such as when the transportation started, when the transportation ended, and when the container's temperature reach or exceed upper threshold. The stakeholders then could ask to the driver to ask for confirmation if there was any notification sent to their mobile phone.

The disadvantages of this device are in need of electric power supply and GSM signal network to perform. Lack of GSM signal network during transportation could affect the notification message delivery and information given into stakeholders mobile phone may not actual, or even the device failed to deliver the notification message.

IV. CONCLUSION

In this paper, we combine cold chain transportation with open source platform software and hardware to create an inexpensive system and prototype to monitor temperature during cold chain transportation. This configuration and model allow small and medium-sized enterprise (SME) to build temperature monitoring device with low cost. With this model, stakeholders related to cold chain transportation can easily receive report and log file about temperature history of their product and ensure quality product. For distributors this device also used to diagnose whether there was any failure or interference with their refrigerated truck equipment. The advantage of this device is easy to modify and duplicate because using open source platform. The disadvantage of this device is require electrical power supply and GSM network signal

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