Android based Wireless Sensor Network (WSN) mobile application on humidity and temperature environmental monitor using CC2650 sensor tag

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Abstract. This research proposed environmental sensing humidity and ambient temperature or object use CC2560 Texas instrument sensor tag device. This device will be implemented on a mobile app to detect surrounding humidity and temperature environment, hoping that it will be used to monitor the user’s daily activity. The sensor will transmit raw data to a central data collector mobile app using Bluetooth Low Energy (BLE) communication and configured with the other same device CC2650 sensor tag in a field with Wireless Sensor Network (WSN). Temperature and Humidity sensing was doing with distance to testing the accurate and sensitivity about the sensor device and the sensor is going work well when the time sampling in second time, the humidity and temperature can follow and change with real time sampling until 30s start from 30.12 and humidity start from 85.81 percent because of specification of the sensor device data transfer very fast wit Bluetooth Low Energy / multi-protocol 2.4 GHz and wireless MCUs with 352-kB flash and 80-kB SRAM, so the device get very little energy, low cost, and have good durability can access data and transmit for a long time.

1. Introduction
The future of technology, internet will be most usable around 26 until 50 billion in 2020 and 100 billion internets connect around the world [1]. We can connect to the other people more easily use any device, mobile or computer sensor in our life [2,3]. In the future the climate will change randomly, research or journal about concept of environmental sensing use IoT to solve the problem in our environment. We need to care to each other about healthy. Some earlier research came study about climate problems, unique ecology, and how the weather is changing [4].

While we do our activity, we can connect sensors to the other places, example the information from hospital can access with other device or user on somewhere else like public transportation, and they will know about humidity and temperature at hospital in that time. Sensor device will contribute the information from another place if we still connect with them. In this part IoT wireless sensor network is very important to sharing about information sensor to the other users and help prepare if they want to go outside or somewhere else.
Device will connect by smartphone Bluetooth and use internet connection from smartphone to send humidity and temperature data, however the location and position place from device can detect and tracking in our web hosting use longitude and latitude from GPS smartphone access permission. Then data will be collected in firebase to processing, grouping or classification the data based on standard health percentage with visual human interface.

This Paper describes a challenge create a simple and friendly user sensor system especially in Malang, Indonesia that can be operated in school, public transportation, public places and another places with sensor tag CC2560 device and use mobile app android to collected data humidity and temperature more save energy to preventing the global warming.

2. Sensor tag CC2560
In order to provide an executable for small system sensor devices we use sensor tag cc2560 was designed by Texas instrument. The sensor device is use for detect humidity and temperature data in somewhere else. Connected to a smartphone Bluetooth the sensor transmits raw data and collect data to forward to the server or firebase. We focus on the following requirement sensor device first is compatibility, sensor must small and easy to bring while we do our activity, second is functionality, sensor must connect with smartphone is wireless connection like Bluetooth, last is durability, long lasting battery and low-cost energy must be worn on sensor device.

2.1. Specification sensor tag module 1
The device generally must simple, long lasting battery, low energy cost, and fast enough to develop and transfer data cause the program from android studio always increase and update every time. that why we choose sensor tag CC2650. there is specification for hardware sensor module from Texas instrument about sensor tag CC2650.
Sensor tag CC2560 Texas instrument has 5x4 cm dimension so tiny and the weight just 28gr, it so wearable and mobile easy to carry out. Sensor Tag is based on the CC2650 wireless microcontroller (MCU), offering 75 percent lower power consumption than previous Bluetooth products [5].

2.2. Specification sensor tag module 2
This allows the Sensor Tag kit to be battery powered, and offer years of battery life from a single coin cell battery [6]. Cloud connectivity lets you access and control your Sensor Tag kit from anywhere. Pin-to-pin compatible with the Simple Link Bluetooth Low Energy / multi-protocol 2.4 GHz CC2642R and CC2652R wireless MCUs with 352-kB Flash and 80-kB SRAM [7].

3. Application
We have developed application system using android studio for collect data temperature and humidity from sensor tag CC2560. We try with 1 device sensor tag to detect the sensor and can open them in mobile application. Sensor connect with smartphone use Bluetooth low energy (BLE) work properly they can send data or transmit raw data temperature and humidity sensing. In android studio we change and developed UUID data sensor to number of temperature and humidity sensor. There are the programs to detected sensor use android studio.
Figure 5 is declared import Bluetooth connection and permission in application to use Bluetooth connectivity with sensor tag cc2560. Bluetooth from smartphone must be always on while data transmit occur.

Figure 6 is configuring data transfer in mobile app from sensor tag cc2650 and change UUID binary data to temperature and humidity number. It detected the sensor and collect the data temperature and humidity sensor.
Figure 7. Bluetooth low energy is on.

Figure 8. Android mobile application.

Figure 9. Permission app to bluetooth connection.
After temperature and humidity have been detected, we improve the location where the device will be found it, so we create a script to show longitude and latitude from the smartphone who connected with sensor tag Bluetooth Low Energy. With android application monitoring Sensor and location can push to firebase with internet connection of the smartphone so the smartphone should connect the internet always to send data to firebase and we can collect the data from that. Here the figure about location access in application below.
Figure 12. Location access program.

Program 5 is algorithm to allow access location and detection of latitude and longitude from GPS smartphone. They send and push the data location to the firebase using internet connection and position of user on smartphone.

Figure 13. Device connected with smartphone.

Figure 13. Show about device sensor tag cc2560 Bluetooth Low Energy (BLE) connected with the application BLE sensor in android smartphone, there are current location, current data sensor in real time and actual temperature and humidity. The data will always push to firebase with internet connection and Bluetooth from smartphone.

4. Experiment and measurement
Sensor testing from sensor tag cc2560 device is accurate and the time is following with data sensor read. We try and search about the sensitivity and delay time data transfer to firebase data cloud in google console. The sensor read humidity and temperature from 5m distance to smartphone will be connected with sensor tag cc2560.
The graphic show humidity and temperature in axis y right and left to read the value of data they are going together with time sampling in 30 second in below graphic and there are not delay time also the accurate from the sensor is good. Temperature start from 30.12 and humidity start from 85.81 percent, temperature is steady at 13 second time sampling in 30.22 °C while humidity reaches 85.80 percent. we try this in outdoor or field so the humidity and temperature can change in any condition.

Figure 15 is application layout and there are data real time with date, month, hours, minutes until second so user can know about the sensor when take the data and transmit data from sensor tag trough the smartphone use internet connection to cloud or firebase google console. Then we collect the data in firebase to memories and save them. The function of firebase is to store data that has been transferred from a smartphone connected to CC2560 tag sensor and clustering data into easy to read data. In next research we using bayes or KNN algorithm to clustering raw data.
Figure 16. Humidity data in firebase.

Figure 17. Temperature data in firebase.

Figure 18. Real time in firebase.
5. Conclusion
This paper presented abstracting environmental sensing to detect humidity and temperature in mobile application use android studio to developed the program with sensor tag CC2560 as sensor device. The specification of the sensor is work properly and can access data transfer quickly with BLE multi-protocol 2.4 GHz and wireless MCUs with 352-kB flash and 80-kB SRAM. So, they get consume the energy is very small and low-cost energy. Durability from sensor also good and long lasting to get data for a long time and we can connect with GPS from smartphone to know about the condition or surrounding in another place.

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