Remote Access Weather Monitoring System Based on Soft Real-Time System (SRTS)

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Remote Access Weather Monitoring System Based on Soft Real-Time System (SRTS)

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***Abstract*— Nowadays, along with the uncertainty changing of temperature and weather conditions, the need of a real time informative applications of weather conditions is really high. This research makes an application that can provide information about weather conditions at a particular location in real time. Although some research had been developed, however the application is still cannot provide direct weather information from the desired location accurately and real-time. The system is designed using DHT11 sensors, rain sensors, LDR sensors, BMP 280 sensors and IP Cameras. The real-time's concept used is Soft Real-Time System (SRTS). Based on the testing process that performed at different times, we have a temperature variation of 220 ˚C – 380 ˚C, humidity 10%-70% RH is generated and the response time of the system is in range 151ms – 157ms. This data then compared with the data from several weathers forecast application in some media. Data is sent and stored to the data base and then displayed in web application also mobile application. Based on that information, the user can get information directly in real time conditions due to weather conditions at the destination location by click the camera button.**

***Keywords*— temperature; weather; DHT11 sensor; LDR sensor; BMP280 sensor ; SRTS.**

I. INTRODUCTION

Information of temperature and weather conditions in a region or an area is one of the most important needs for the community. Sometime, people who need to mobile from one place to another place need the information about the weather at the destination. If the weather at the destination is rainy, then they have to prepare the umbrella. Nowadays, the climate and weather had changes erratically. The main cause of climate and temperature changes are the occurrence of global warming that comes very significantly. This will cause the weather and temperature change easily. The Intergovernmental Panel on Climate Change (IPCC) project shows climate change will have an impact on natural cycle changes that caused by global warming, especially at temperatures, sea levels, precipitation, and extreme events. Globally, there has been an increase temperatures ranging from 0.20 C to 0.60C in the last few centuries [1]. Based on the rising temperature values, it also can lead to temperature rise, changes in weather pattern, changes in air humidity and also in air pressure.

Other factor that can affect the differences of temperature is climate changes which is result in rising temperatures in an area. Based on the occurred of temperature and climate changes on July 1, 2017, there has been occurs a temperature difference at the same time. According to GO Weather Forecast-Widgets application and Weather Radar-Forecast application, temperature in Bandung area on July 1, 2017 is 22 ˚C, cloudy. But according to Weather application the temperature of the same area is 190C. These three existing applications show the differences of the actual condition in the same area.

Based on the description above, there is no system that can provide information on the actual condition at a location. Therefore, in this research we will build a system that can monitored temperature and weather that can be accessed by the user in real-time and besides that the weather can be watched directly through IP cameras that implemented near the sensor. In this research, the related issues of climate and weather that will be measured are temperature, air pressure, humidity, wind speed and rainfall. The observation will do by monitoring of current temperature and weather conditions compared to weather stations and BMKG that have a very important role that serves as observations of weather and atmospheric conditions of the earth that will provide information on weather forecasts in some area or places [2].

This research also aims to help the people who need the information about the weather in one destination or in one area as a real-time condition and precisely.

II. PROPOSED SYSTEM

A. Literature Review

The first step in preparation of research is conducting study literature on some relevant research before. Rania et.al do the research to forecast the weather using naïve bayes method. Weather forecast are predicted by calculating opportunities based on past experiences [3]. Sumantri et.al, do the research to make monitoring system via web service in order to help the community to make preparations in case of rain to travel from one place to another place [4]. Hidayat et.al making telemetry and weather monitoring system included rainfall, temperature, humidity, wind direction, wind speed and the intensity of sunlight wirelessly [5]. Susmita et.al do monitoring a system that can embedded into weather monitoring system. It is also make the detection gas and humidity that can sent SMS using GSM Module [6]. Other research also submitted by Gahlot et.al. They develop sensor monitoring weather using wireless zigbee technology in order to monitor the pollution [7].

Those previous research have the same parameters to be measured with this research, but no one has used an interface web in a smart phone that can be embed with IP Cameras that can directly provide information to the actual condition that exist in a location real time through the picture.

The weather monitoring system that will be designed is a system that can measure the value of temperature and humidity by collecting and storing the data in the database. Besides that, this weather monitoring system will embed with IP cameras in the location near the sensor system in order to give information through video or picture about the weather in the certain location.

Besides study of previous research, we also conducted study of hardware and software review that will be used in this research. The hardware reviews are DHT11 sensor [8], rainfall sensor [9], air pressure sensor [10], LDR sensor [11], Arduino Ethernet Shield [12], Arduino UNO [11], IP camera [13], Router and Server [14], Web Application. The software reviews are Arduino IDE [15], Xampp, TP-Link Cloud.

B. Architecture System

Before establishing a monitoring system at a particular location, it will explain first about the concept of monitoring development on the hardware section to the internet of things. The hardware used is temperature and humidity sensor using DHT11 sensor, air pressure sensor using BMP280 sensor, light intensity sensor using LDR sensor and rain sensor.

The description of hardware usage can be seen in Table. I below.

TABLE I. HARDWARE

No	Hardware	Usability
1	DHT 11 sensor	Temperature and humidity sensor
2	Rain Sensor	Detect weather conditions at specific locations
3	Air Pressure sensor	Detect the value of air pressure at all three locations
4	LDR Sensor	Detect the light intensity at a particular location
5	Arduino Ethernet Shield	Allow the device to connect to the internet network with a unique identity in a network
6	Arduino UNO	As a microcontroller that can control the sensor
7	IP Camera	Monitor the location in real time
8	Router	Using the router as an intermediary between the microcontroller and the camera with the web server
9	Server	Using server as data storage from temperature and weather sensors
10	Web-based Application	Monitoring medium

Those hardware in Table.I then distributed into three parts of system. Input, process and output. It can be seen in fig.1 below.

Fig. 1 shows DHT 11 sensor, rain sensor, LDR sensor, BMP 280 sensor and IP Camera as an input of the system. Those hardware are able to monitor the condition of the location. Sensors send data of Celsius, humidity, Fahrenheit, air pressure, bulk, and intensity to Arduino UNO, then Arduino UNO will process the data in the processing part of the system.

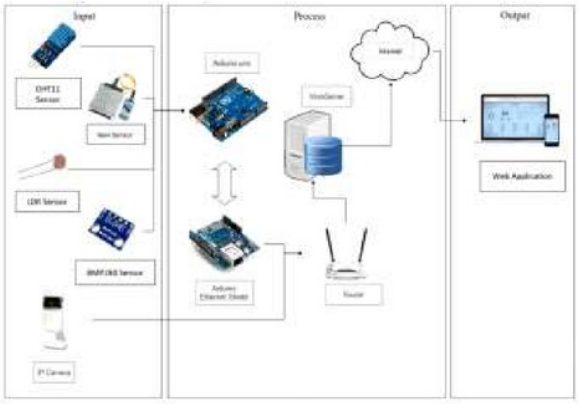

Fig. 1. Proposed System

In the process section there are Arduino UNO, Ethernet shield, router and web server. Web server is used to process data to be sent to web application as an output of the system. While the router is used as a liaison between the microcontroller with the web server. Besides that, the router also can configure IP camera. Microcontroller used in this system are Arduino UNO and Ethernet shield which is used as a communication medium between microcontroller and router. In the output section, there is web application that will be appeared in the monitor in order to monitor the weather.

The description of software usage can be seen at TABLE II. , below.

TABLE II. SOFTWARE

No	Software	Usability
1	Arduino IDE	Coding and Programming
2	Xampp	Web page creation
3	TP-Link Cloud	Configure wireless IP-Camera

The next system architecture that will be described is the device used in the monitoring system.

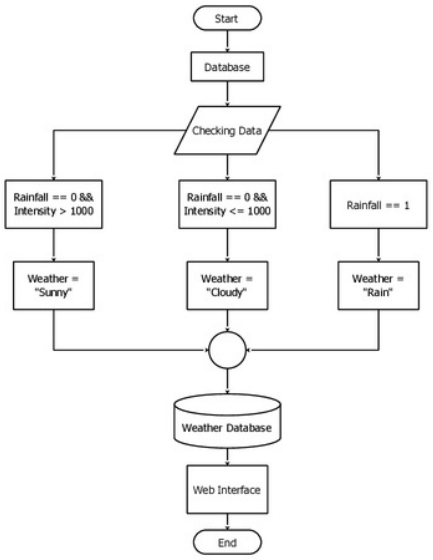

Fig. 2. Flowchart System

Fig.2 above, shows the flowchart of the system. The system initializes all variables on the data, such as the light intensity and rainfall values as data that can be used to determine the conditions. If (light intensity value <= 1000) and (rainfall value = 0) then the condition is categorized cloudy. If the value (intensity>1000) and (rainfall value = 0) then the weather condition is bright. While the categorize of the rain conditions if the rainfall value is equal to 1. Next, all the data will be sent and displayed in the web application.

Fig. 3 shows the flowchart of monitoring system. System starts with the action from the users. In order to access web application, the users should write the domain name. The display will automatically appear in the home or index page. As an interface to guide the user, there are four parts key which can be choose by the user. There are home button, view, graphics, and location. When users choose home button, there are two choices type of the temperature degree that can be chosen, Celsius or Fahrenheit. If the users clicked view button, the user can monitor directly on the location by using IP Camera that implemented near the sensor area. User can see the video or image in real time conditions. Graph button has two options to choose. In this part, users can choose the displayed graph based on the average temperature and average humidity every day and every hour. We implant three location point that have been determined around Telkom University area. Therefore, in button location there are three locations that can be chosen by the user. The user can see the weather conditions and the temperature right at a predetermined location.

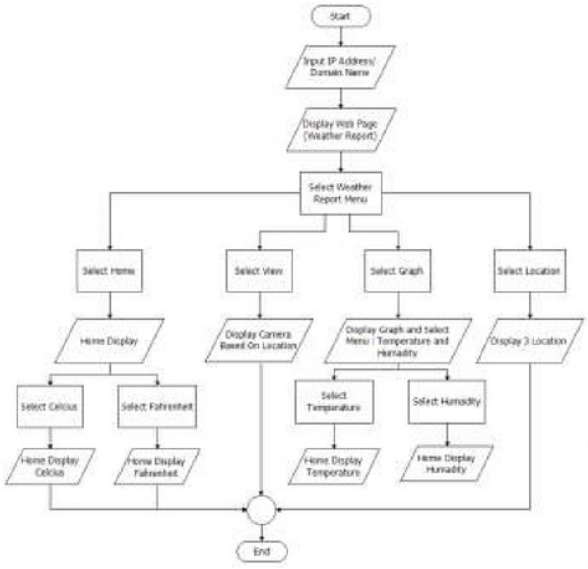

Fig. 3. Flowchart Interface of Monitoring

IP camera installation on this system is using VPN configuration. Concept of VPN by creating a network within the network called secure tunneling. Tunneling is a way to create a private connection path using other network infrastructure.

Fig. 4. VPN Concept Configuration

Fig. 4 shows the configuration of VPN Concept that embedded in this system. VPN performs setting on the Mikrotik used as VPN Client, while the server is available as a VPN server addressing 43.245.187.170. The IP cameras contained in the local network will be translated to the public network. Based on that configuration the users can access the IP camera by using the public network through tunneling access.

Fig. 5 shows the connection system between IP camera, Sensor, and admin as the router. Based on that connection IP camera will get IP dynamically by routerboard

Fig. 5. IP Camera Configuration

III. TESTING AND ANALYSIS

At this stage of testing, a comparison between the current system and the proposed system is performed. The tests conducted are aimed to prove the weather data in real-time by using soft real-time system (SRTS). To be able to perform the test, it will be divided into 4 scenarios. First scenario is testing the temperature and humidity, second scenario is testing the weather condition, third scenario is testing IP camera, the last scenario is testing the response time sensor data to the server.

A. First Scenario

This scenario aimed to test the condition of the weather in one day. The weather condition is take the data displayed every minute continuously and update automatically in web application.

TABLE III. COMPARISON WEATHER CONDITION

Time	Attribute	Proposed System	GO Weather Forecast & Widgets	Weather	Hygrometer and Thermometer
08:00	T°C	29°C	19°C	20°C	27°C
	Humidity	43%	73%	87%	45%
	Result	Sunny	Sunny	Sunny	Sunny
09:00	T°C	33°C	23°C	22°C	31°C
	Humidity	32%	69%	85%	34%
	Result	Sunny	Sunny	Sunny	Sunny
10:00	T°C	38°C	26°C	24°C	37°C
	Humidity	22%	73%	82%	23%
	Result	Sunny	Sunny	Sunny	Sunny
11:00	T°C	42°C	25°C	25°C	41°C
	Humidity	9%	52%	51%	10%
	Result	Sunny	Sunny	Sunny	Sunny
12:00	T°C	48°C	25°C	26°C	46°C
	Humidity	9%	53%	51%	10%
	Result	Sunny	Sunny	Sunny	Sunny

Based on TABLE III. above, it can be concluded that although there are differences in temperature and humidity values, but all of the application produces the same conclusion, "sunny".

B. Second Scenario

This Second scenario is a test done by doing capture image which is taken from IP Camera that is connected to the system. The testing of IP camera is able to monitor the location directly and in real-time condition. The result of this scenario is listed in Table VI. The location of the placement sensor and IP camera is on the roof top of the applied science department's building of Telkom University.

TABLE IV. shows the result of sunny scenery at a location and also cloudy scenery in Telkom university area.

TABLE IV. TESTING IMAGE OF IP CAMERA

Time	T (°C)	Humidity	Condition	Image IP Camera
04:00 PM	30°C	42%	Sunny	
05:00 PM	27°C	51%	Cloudy	

The data can also connect into the IP camera by clicking the button on google map display. The display is showed in Fig. 6

Fig. 6. Map Display.

C. Third Scenario

This scenario aimed to test the time response system to server in order to prove the data delivered in real-time condition. The response time that occurs when sensor data is sent to database on the server. The response time is shows in Fig. 7

Based on the tests performed, can be seen in fig. 5 the list of information before the sensor data is sent to the database. The initial time will appear in the serial monitor when the sensor is ready to work in milliseconds.

Once the data is appeared, the sensor will start sending the data into database server. The time will be displayed at the end listed time in milliseconds. After the start and end time data is appears, the time obtained from microcontroller sensor data sent to the database server with the final time formula minus initial time in milliseconds.

The testing results generated varied in the range of 150 milliseconds until 157 milliseconds. The response time testing is in the range of soft real-time system categorize, where the system is allowed for missed deadline as long as task are executed and still measure a value [16].

Fig. 7. Response Time Testing.

IV. CONCLUSION

Monitoring weather conditions and temperature (climate) are depend on the conditions of any sensor that used in the system. In this researched we take the monitoring from the condition of light intensity, rainfall value, and the humidity in appropriate sensor position. Based on the result testing, we can state that the difference value measurement with the application system currently is about 10 C-6°C

approximately and all measurement are depended to the height position of elicitation data.

The more sensor installed at each part of an area, the more accurately temperature is measuring. Because the data in an area is displayed by measuring average temperature value that had been implemented in one area.

According to SRTS system, the time delay that can be used to be able to send data from sensor to web server is 5 minutes. But in testing result the approximately time is about 150 milliseconds until 157 milliseconds.

The advantage of this proposed monitoring system is the use of IP cameras that allow users to watch and see the real condition in a destination location directly or in real-time. Besides that, this system has a good interface using google map that navigate the user to find the location based on map.

Furthermore, this system is good to implement for tourism site, where the user can monitor the tourism location based on application. They can check the situation whether it is sunny, cloudy or rainy on sites.

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