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Smart Home Integrated With Internet Of Things (Iot) In The Digital Era Of Industry 4.0

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Abstract. Smart Home is one form of technological progress in the Industrial Revolution Era 4.0 that facilitates human activities in controlling and monitoring the condition of the home that is not limited to distance by utilizing electronic equipment, the internet, and smart phones[1]. In this research, a prototype of Smart Home with Internet of Things (IoT) which is equipped with a proximity sensor (HC-SRF04) to open and close the door of the house automatically, a temperature sensor (LM35) in detecting the integrated room temperature on and off based on the fan room temperature, and lights and fans that can be controlled remotely by using the internet and smartphones. Android application to control and monitor homes in Create by using the Blynk application. The Temperature Sensor and Proximity Sensor on Smart Home are tested using Industry standard distance and temperature measuring devices (digital thermometers). The accuracy value of the device reaches 98.22% for distance measurement, and 98.50% for room temperature when compared with industry standard tools. Android applications have been successfully tested in several types of smartphones with different brands and specifications. The distance of the smartphone to the Smart Home location in monitoring and control was successfully tested and worked well at the closest distance of 5 meters to the farthest distance of 17,466 km (State of Mexico), all of which use the Internet.

1. Introduction

Smart Home is one part of technological advances in the field of automation, especially in terms of controlling household electronic devices that are integrated with smartphones[1]. One example of its products is the use of sensors for several household electronic devices that can be controlled and monitored at any time with a smartphone connected to the internet. So that the use of electrical power for electronic devices and lights can be controlled and monitored by homeowners, in their efforts to save the maximum use of electric power load[2]. Aside from being a control and monitoring, smarthome in other studies can also be used for home security, one of the examples of its application is using an RFID Card (changing conventional keys using ID Card) for a key security system on a house door. This is done in an effort to reduce theft [3]. Smart home is a place to stay with automated systems that are sophisticated in controlling and monitoring lighting and room temperature, household appliances, multi-media equipment, and security systems and many other functions. Internet of Things (IoT) [4] plays an important role in building smart homes. Through IoT almost every object of

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our daily life at home can be connected to the Internet. IoT allows monitoring and control of all these connected objects regardless of time and location [2]. In addition, the system of Smart Home can also be applied in the medical field, especially in patients who enter the recovery period after being hospitalized, where some physiological parameters need to be measured continuously and monitored by the hospital. Therefore telemedicine and remote monitoring of patients using Inernet of Things are increasingly important and urgent [5][6]. In this research, Prototype Smart Home was created to monitor Room Temperature, Room Fan, Room Light, and Open or close the door of the room with Internet of Things communication integrated with Android Smartphone. The working principle of Smarthome in this study starts from the room temperature which is read by a temperature sensor (LM35) which exceeds 28 oC will have an impact on the condition of the fan will be active. this is done to reduce the room temperature. Room temperature that can be read will also be monitored on an android smartphone. Proximity sensor (HC-SR04) is used to detect obstruction of objects in front of it, or human distance that is read on the sensor. If the read obstacle is less than 15 cm then the motor will be active to open the door of the house, but if the read distance is less than 15 cm then the door will close. For lights on this prototype smarthome can be turned on and off with an Android smartphone. The Smarthome prototype can be connected to the Internet, and the Android application is created using Blynk software or MIT App Inventor.

2. Research Methods

The Smart Home System diagram in this study (Figure 1) was made using NodeMCU ESP8266 as the main microcontroller which functions as a hardware liaison with the Smartphone. The working principle of the internet connected NodeMCU microcontroller will send data to the webserver from Blynk, then forwarded to an android smartphone so that the hardware can be controlled and monitored even over very long distances. The working principle of the Smarthome Prototype uses proximity sensor (HC-SRF04) which is placed in front of the door to detect the presence of humans or objects approaching. Distance information that is read will provide information to the microcontroller to enable the door to open or close automatically. The temperature sensor (LM35) placed on the Smarthome protopyte is used to detect room temperature, and activate the Fan when the room temperature is more than 28 oC and turn off the Fan when the room temperature is less than 28 oC. Room temperature can be monitored with an Android smartphone, to turn off and turn on the Fan and the Lamp can also use an android smartphone. The Android application that is used to control and monitor the Smarthome is created using the Blynk software application and the MIT App Inventor software. Distance is not an obstacle to control and monitor, as long as the Hardware and Smartphone are connected to the internet.

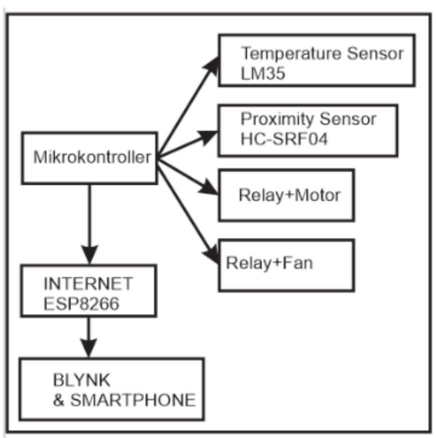

Figure 1. Android Smartphone Block diagram of Muhammadiyah University of Sidoarjo

3. Results And Analysis

The appearance of the Smarthome Prototype along with the Smartphone Application that has been made is shown in Figure 2 below. For Smartphone Applications, the authors use the Blynk Software and MIT App Inventor software in its manufacture. For MIT App Inventor, the writer uses ThingSpeak as a webserver. For Blynk there is automatically a web server. The HC-SR04 ultrasonic sensor test is performed to determine its level of accuracy when compared to distance measuring devices that are in accordance with industry standards. Tests in this study were carried out by giving different distances and were repeated 5 times.

Figure 2. Smarthome Prototype

Figure 3. Smarthome Android Application with MIT App Inventor

Figure 4. Smarthome Distance control and monitoring testing

Table 1. Distance sensor Accuracy Testing (HC-SR04)

No.	Electronic Distance Measurement	Proximity Sensor test (HC-SR04) which is to number-					Average	Standart Deviation	Deviation	Accuracy Tools
		1	2	3	4	5				
	cm	cm	cm	cm	cm	cm	cm		cm	%
1	6	6	6	6	5.9	6	5.98	0.04	0.02	99.67
2	12	10	12.1	9	11.9	11.4	10.88	0.133	1.12	89.71
3	18	18.3	18.3	18.3	18.3	18.3	18.30	0.00	0.30	98.36
4	24	23.9	23.8	23.9	23.9	23.9	23.88	0.04	0.12	99.50
5	30	29.6	29.7	29.9	29.9	29.9	29.80	0.14	0.20	99.33
6	35	35	35.2	35.9	36	34.8	35.38	0.54	0.38	98.93
7	40	40.2	40.5	39.7	41	42	40.68	0.88	0.68	98.33
8	45	45	44	45.5	45.9	46	45.28	0.82	0.28	99.38
9	50	50.6	50.7	50.9	50	49.6	50.36	0.54	0.36	99.29
10	55	55	54.4	55.4	54.8	56	55.12	0.61	0.12	99.78
			Average					0.49	0.36	98.22

Based on table 1 for testing HC-SR04 sensors conducted with 10 variations of distance and repetition of measurements carried out 5 times, obtained information on the average accuracy of distance sensor (HC-SR04) is 98.22% of the Industrial standard Distance Measuring Instrument . The difference in the measurement results of the proximity sensor (HC-SR04) to the Industry standard Distance Measuring Instrument ranges from 0 - 1.12 cm, with an average standard deviation of 0.49. The resulting standard deviation is very small, the resulting small value implies that the proximity sensor (HC-SR04) works well and is stable even though it is tested with 10 different distance variables and the measurement of each distance is repeated five times. Proximity sensor (HC-SR04) in detecting distance or humans who are in front of it works well at a distance of 6-55cm. Besides being able to inform of obstacles and inform the distance value in the Smarthome case, the proximity sensor (HC-SR04) can also be applied to other objects such as "Smart blind stick". "Smart blind sticks" that use sensors (HC-SR04) can be implemented successfully. This can be used as an effective navigation tool for the blind. On the detection of obstacles in the path of the person (blind person), the "Smart blind stick" can ring the bell to make a warning. This system can detect any obstacles in the range of 5–35cm [7]. Besides the application of a proximity sensor (HC-SR04) can also be used to detect water level [8].

Table 2. Testing the accuracy of the temperature sensor (LM35).

No.	Electronic Temperature Measurement	Temperature Sensor test (LM35) which is to number-					Average	Standart Deviation	Deviation	Accuracy Tools	Error Tools
		1	2	3	4	5					
	cm	cm	cm	cm	cm	cm	cm		cm	%	%
room 1	27	27	26	26	27.8	26.8	26.72	0.76	0.28	98.95	1.05
room 2	26	26	26.4	26.3	26.2	25.8	26.14	0.24	0.14	99.46	0.54
room 3	27.5	27.8	27.3	26.8	26.2	27	27.02	0.59	0.48	98.22	1.78
room 4	28	27	27	26.3	27.8	29	27.42	1.03	0.58	97.88	2.12
room 5	25	25.4	25	25.4	25.8	26	25.52	0.39	0.52	97.98	2.04
Average								0.60	0.40	98.50	1.50

Based on the Temperature sensor (LM35) testing table which is done with 5 variations of room temperature and 5 times the measurement repetition, it is found that the average accuracy of the Temperature sensor (LM35) is 98.50% against the Industrial standard Temperature Measuring Instrument. The difference in the measurement results of the Temperature sensor (LM35) against an Industrial standard Temperature Measuring Instrument ranges from 0.14 - 0.58 oC, with an average standard deviation of 0.60. The resulting standard deviation is very small, the resulting small value implies that the Temperature sensor (LM35) works well and is stable even though it is tested with 5 different room variables with temperature measurements in each room repeated five times. The average percentage error of the LM35 sensor temperature in detecting room temperature is 1.50% with a range of error percentage values of 0.54% to 2.12%. this is different when compared to the LM35 sensor temperature in detecting the temperature of burned peatlands in the disaster mitigation system of burning peatlands. In the case of detection of burning peatland temperatures, the temperature read by the temperature sensor (LM35) has an average percentage of temperature sensor error (LM35) of 0.22% with a range of error percentage values of 0% to 0.62% [9]. So it can be concluded that there is an error difference when the temperature sensor (LM35) is used to read the room temperature when compared to reading the temperature of burning peatlands (1.50% - 0.22%), the resulting error difference is 1.28%. This is due to the accuracy of each LM35 sensor and the way the temperature sensor (LM35) sensor is taken for each object and is different from each other. Apart from being read information on the room temperature in the Smarthome case and the hot temperature of the burning Peatland, the temperature sensor (LM35) can also be applied as another project, such as used to measure human body temperature [10].

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Table 3. Testing distance control and monitoring of Smarthome prototypes with smartphones utilizing the Internet of Things

No	Distance (Km)	type of android smartphone	Button for Lamp	Button for Fan	Button for Temperature	Information
1	0,005	Oppo F1s *4G *RAM 3GB Android 5.1 (Lollipop) *Wi-Fi 802.11 a / b / g / n, dual-band,	1	1	1	at Gempol - 5 meter
2	3,3	Asus z live *4G *Ram 2gb *Wifi 802.11b/g/n	1	1	1	at Gempol - Kejapanan
3	45	xiomi redmi note 5 *4G *Ram 3gb *Wifi Wifi802.11 A/B/G/N Wifi Diretct, Hotspot	1	1	1	at Gempol - Mojoagung
4	64	huawei y5 *3G *Ram 1gb *Os Android (5.1) Emotion 3.1Lite UI	1	1	1	at Gempol - Lowakwaru (Malang)
5	131	Oppo a37 *4G *Ram 2gb *Os ColorOs 3.0 based on Android 5.1	1	1	1	at Gempo - Kaliwates (Jember)
6	625	iphone 5s *Ram 1gb *Os ios7 *Wifi Hotspot wifi, Dua band	1	1	1	at Gempol - Cengkareng (Jakarta)
7	17466	xiomi 4x *4G *Ram 2gb *Os android 6.0.1 (marshmallow)	1	1	1	at Gempol - Cozumel (Mexico)
	Rata rata		1	1	1	
	Standart deviasi		0	0	0	

Information :

a. Condition 1 states that the communication conditions has been linked with a Smartphone.

b. Condition 0 indicates that the communication conditions are not connected to the Smartphone.

In table 3 about testing Android smartphones based on internet of things for 7 different distances can be sent properly when connected to a WiFi network or the internet. In this study, testing the control and monitoring of the prototype Smarthome with a smartphone for the closest distance is at a distance of 5 meters and the farthest distance is at a distance of 17,466 km (Country of Mexico). Testing on the Xiaomi Mi 4x Android smartphone that has an internet connection with a 4G network (faster internet connection speed) runs well. From the results of tests that have been done, the network and internet connection speed greatly affect the sending of data between the Smartphone and the Smarthome Hardware, and vice versa between the Smarthome Hardware and the Smartphone.

4. Conclusion

Prototype Smart Home with Internet Of Things (IoT) equipped with proximity sensor (HC-SRF04) and temperature sensor (LM35) in detecting room temperature, as well as monitoring and controlling to turn on and turn off lights with an android smartphone can work well. The accuracy value of the device reaches 98.22% for the measurement of distance, and its accuracy reaches 98.50% for the measurement of the room temperature if its value is compared with an industry standard tool. The Android application was successfully tested on several types of smartphones with different brands and specifications. The smartphone's range of distance to the Smart Home Prototype location to monitor and control the SMarthome Hardware was successfully tested and worked well at the closest distance (5 meters) to the farthest distance (17,466 km (Country of Mexico))..

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