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Design of an early fire detection system based on GPS module

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Abstract. The purpose of this study is to build an early fire detection system that is able to detect the conditions of the environment and the results are informed quickly on the incident area and fire department. The research method used was experimental using Arduino Uno, GPS Ublox Neo 6MV2, SIM900A and three sensors such as fire sensors, smoke sensors and temperature sensors. All sensors function as a fire indication detection system. The results of the system test obtained an average GPS error of 1.6% with an accuracy of reading shifts and the average distance obtained was ± 4 meters. The average data transmission speed between Providers is 1 second because the processing time and sending speed are in line with the network conditions and the capabilities of the GSM module used.

1. Introduction

Events or series of events that threaten and disrupt people's lives and livelihoods caused by natural factors, non-natural factors, or human factors that cause fatalities, environmental damage, property losses and psychological impacts [1]. Every fire process always causes smoke and heat and causes an increase in temperature in a place or room where a fire occurs. Fires occur due to chemical reactions between flammable substances and oxygen through the combustion process. The greater the oxygen content, the greater the fire that will ignite [2].

Areas with densely populated areas are vulnerable to fire disasters. Based on data from the City Fire-Disaster Management Agency of Balikpapan City, 54 fire cases occurred in Balikpapan, East Kalimantan, during January to September 2017, with 22 cases of which hit the densely populated residential environment in West Balikpapan [3]. This shows that the problem of fire in urban areas needs serious attention, especially in terms of prevention and mitigation.

Several studies related to fire information delivery systems have been carried out, including microcontroller-based fire detector systems that send information via mobile phones. In this system MQ-2 is used as a smoke sensor, Uvtron as a fire sensor, a mobile phone as a sender of information, and the ATmega32 microcontroller as a controller [4]. Fire detection using the SMS notification system using SIM900, MQ-2 sensor that can detect smoke from fire and LM35 sensor to detect the temperature of the fire, so that it can provide a warning if a fire occurs when the homeowner is outside the house. All components are controlled using Arduino Uno [5]. This detector uses a temperature sensor and smoke sensor that can detect fires early. The system design starts from a series of

temperature sensors, smoke sensors, analog to digital voltage converters with ADC 0809, system controllers with AT89S52 microcontroller, and alarms as indicators of fire. The results showed that the prototype of a fire detection system that was designed could detect fires based on information from temperature and smoke sensors, and activate an alarm as the indicator would sound [6]. Research development on fire detection using Wireless Sensor Networks [7,8].

However, all of these systems send information only in the form of short message services (SMS) that read "HAPPEN FIRE" and the sound of the Alarm as an indicator of a fire, without information about the location of the incident. The problem that often occurs so far is the delay in the presence of the fire department at the fire location. This can be caused by two things. First, the lack of staff preparedness. Second, the delay in information received by officers (via emergency telephone number 113) from residents who experienced or were around the disaster and heavy traffic to the location of the fire. With the smoke, temperature and fire detection system, it is expected that fires can be known as early as possible and delivered quickly, and can send the scene automatically to the nearest fire department. This step is the first step for human safety in the event of an unwanted fire.

2. System design

The research conducted is the design and manufacture of tools as an early warning for fires in people's homes. This tool is made to make it easy for firefighters to find out the location of a fire. The working process of this tool consists of several components, namely LCD for the viewer, buzzer for the sound indicator, LM35 as a temperature gauge, MQ-2 as a smoke level gauge, and a flame sensor as a fire detector. For sensor circuits, such as MQ-2, LM35 and flame sensors are connected to the microcontroller and given a value limit, if each sensor has a value more than the normal limit and then the microcontroller will send location data via GSM, the SIM900A module. Figure 1 and Figure 2 shows the Block Diagram for senders and recipients.

For microcontrollers using Arduino UNO as a data processor that is connected by the SIM900A module as a data sender. Whereas the output or receiver is connected to SIM900A and forwarded to the Arduino UNO microcontroller as a data processor in the fire that is used to display the location of the fire using a 16 x 2 LCD and the Buzzer will sound as an indicator of fire. While the mobile application will display fire notifications to homeowners as well as Smartphones will also receive SMS notifications of fire locations to firefighters.

Figure 1. Send and receive devices.

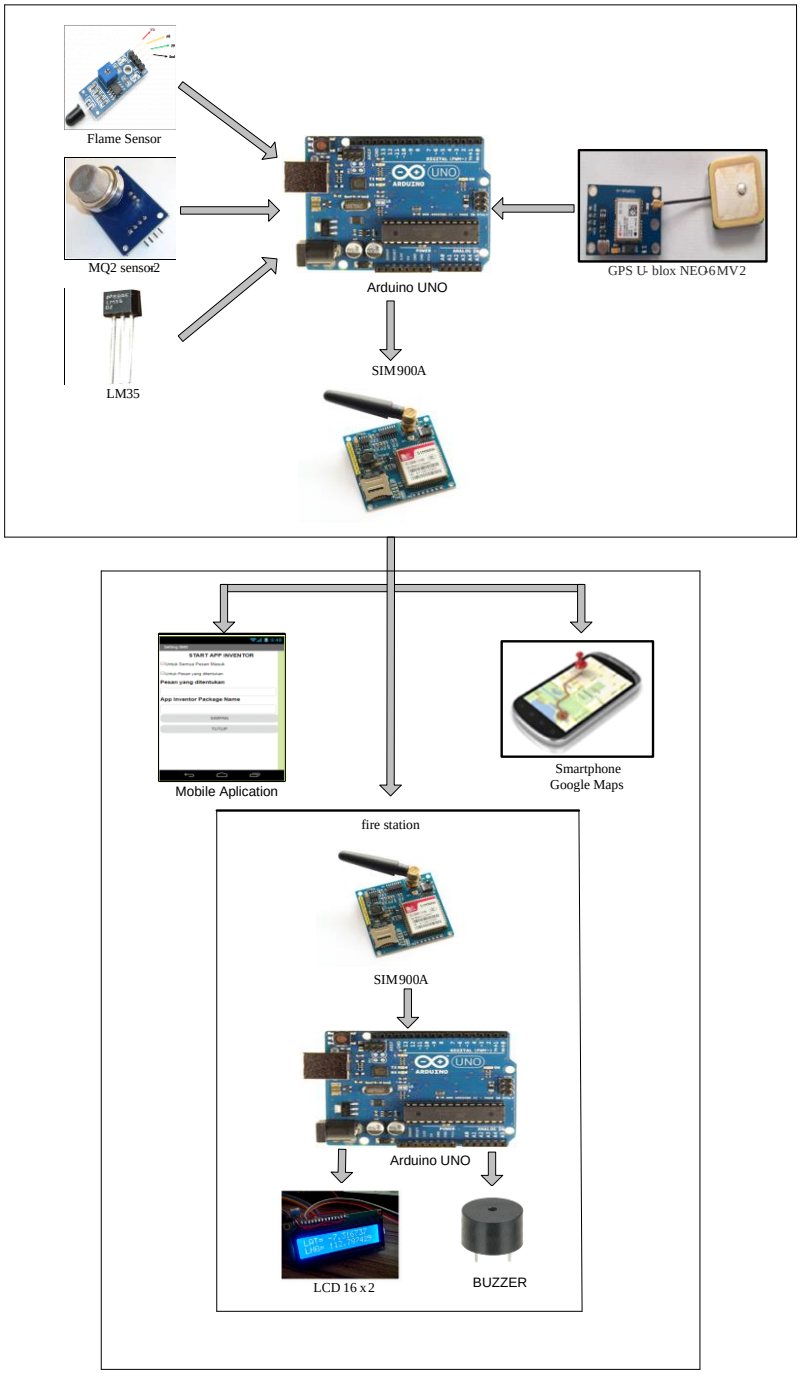

Figure 2. Send and receive devices.

2.1. Receiver and sender system

Below this is the flow diagram shown in Figure 3 is the fire warning sender and Figure 4 is the fire warning receiver.

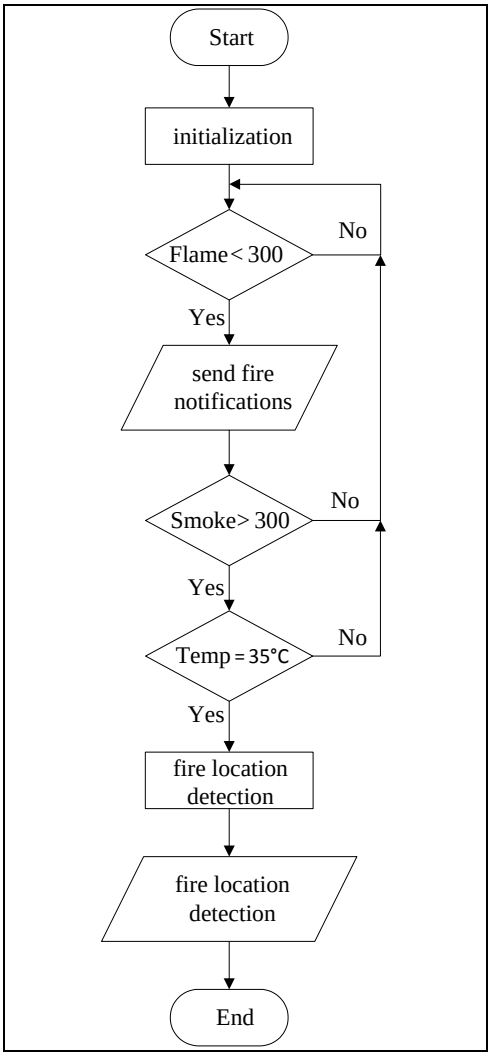

Figure 3. Receiver and sender system.

The first step of the flow chart in Figure 3 is initialization. After initialization, the next step is the reading of the three sensors, including the fire sensor, the smoke sensor, the temperature sensor. If during the first condition, there is an indication that a fire will occur, the sensor will read with a limit value (<300) when the sensor is working, when the value is reached, the system will send a notification only to the homeowner. When all sensors detect an indication that there will be a fire with the appearance of fire, smoke and temperature rise, the sensor will read with a value limit to activate the sensor to be active, namely: the value (> 300) is the condition when the smoke is read, and the temperature is ≥ 35 ° C, the GPS will activate and send the location of the fire to arduino and arduino will send commands to GSM to send a warning and the location of the fire. The next step in Figure 4 is to receive a warning and the location received to the firefighters in the form of a location link, homeowners in the form of SMS and LCD displays in the extinguisher's office in the form of latitude and longitude locations and the sound of a buzzer as a sign of a fire.

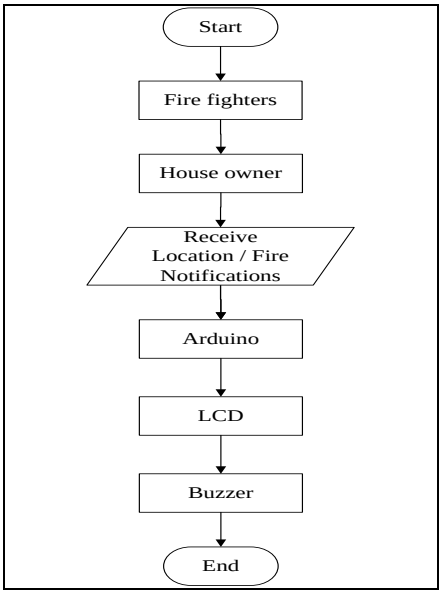

Figure 4. Extinguishing system at extinguisher

2.2. Program application design

Making an offline version of the mobile application was made through the website http://ai2.appinventor.mit.edu. The appearance of the application downloaded via the website "https://puravidaapps.com/sms-receiver.php" and Figure 5 is a display image that is made blocked by the inventor's website.

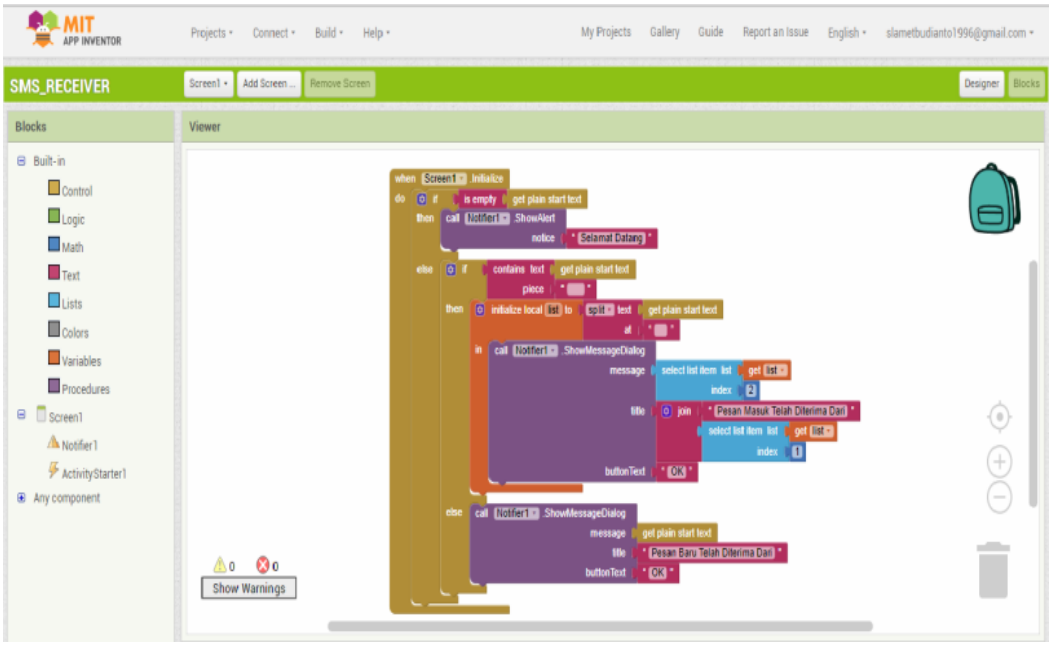

Figure 5. Display AppInventor.

3. Results

This section shows how the results of the coordinates taken by the Ublox Neo 6MV2 GPS are viewed from the Arduino monitor series. The results obtained can be seen as shown Figure 6.

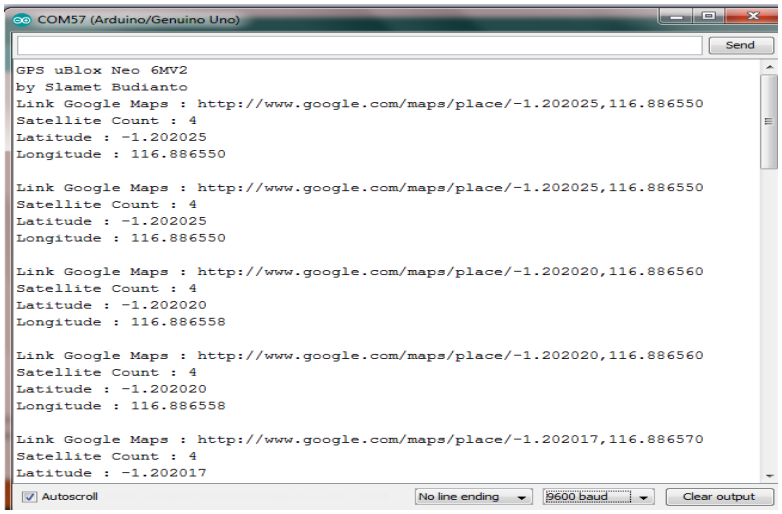

Figure 6. Coordinate results from the Neo6mv2 GPS

On the results of testing the coordinate image obtained from GPS in the form of latitude and longitude along with the google maps link which later the location can be searched via mobile/smartphone, then the location will be seen where the location is. This test is conducted to determine the accuracy of GPS data, because this will affect the location of the fire because if reading data from a GPS error then the location reading cannot be identified correctly. Data from the results of GPS testing are as Table 1.

Table 1. Proof of testing GPS location using a mobile phone.

No	Location	Hand Phone	GPS Neo 6MV2	Accuracy
1	JL.Soekarno-Hatta KM 8 Balikpapan	-1.203002, 116.884170	-1.202898, 116.884159	9 meters difference
2	Politeknik Negeri Balikpapan	-1.201939, 116.886754	-1.202004, 116.886680	11 meters difference
3	Himalaya Residence Balikpapan	-1.193071, 116.888906	-1.193048, 116.888863	7 meters difference
4	Griya Diva Residence Balikpapan	-1.195289, 116.890468	-1.195227, 116.890329	13 meters difference
			Average	± 4 meters
			Error (%)	1,6 %

The table above is the result of GPS readings obtained and proven by handphone through google maps. The function of Latitude and Longitude is to measure the distance between one point and another.

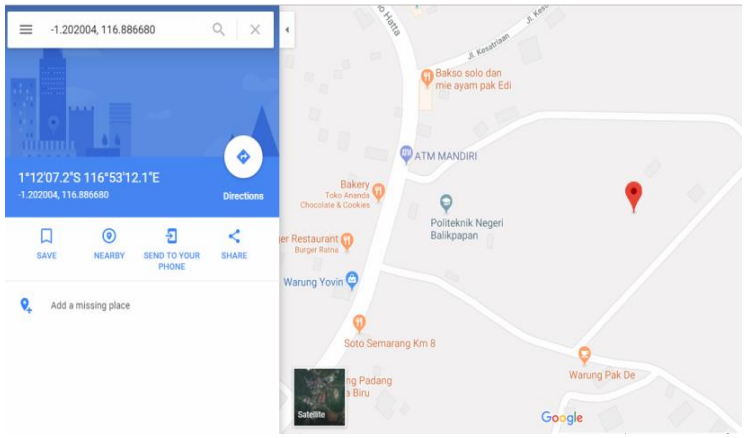

Figure 7. Proof of location access with GPS hand phone.

4. Discussion

Integrated telemetry system aims to facilitate and help the general public, industry, firefighters, forestry services to monitor quickly and precisely. So that it can reduce the impact of fires. This study will develop an integrated telemetry system using multisensor 3D with fuzzy logic as a method for measuring, evaluating, testing and analyzing data from multisensors. Integrated telemetry system uses wireless sensor network topology and internet network for remote monitoring, so that this system can be built a pilot project to produce telemetry systems that are fast, smart, and reliable.

5. Conclusion

The performance of the "Resident House Fire Detection System using a Mobile Application" as a whole can function properly. As a parameter used to determine the level of success of this tool it is able to communicate data between an arduino uno microcontroller to a sim900a gsm device. This tool is capable of sending data obtained by the ublox neo 6MV2 GPS module in the form of SMS and displayed with an LCD. Fire detection notification system in homes that are designed based on smoke content using MQ-2 smoke sensors, and fire temperature conditions using LM35 sensors and flame sensors as fire detectors. These sensors can be said to be quite accurate and can be used on this system. Warnings can be sent without affecting distance. The overall fire detection notification system is quite good in reading and determining the location when a fire occurs shows that the average GPS reading error rate is 1.6% with an accuracy of the reading shift with the average distance obtained is ± 4 meters.

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