

Development of Geo-IoT in Emergency Medical Care and Services Planning using U-blox GPS based on Web GIS

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ABSTRACT

Emergency Medical Care and Services Planning (EMCSp) System has been developed to help and reduce the amount of injury because of the delay in transporting the patient. Due to the original system used by the National Institute For Emergency Medicine to call the 1669 hotline and 1699 mobile application, residents or patients had to have a phone or smartphone to report an emergency and current location from smartphone.

The proposed system has been developed based on the Internet of Things (IoT) technology, Global Positioning System (GPS) and Web Map Application. Thus, in the development of this system, we have designed and developed an IoT system for notification of an incident instead of using phone call or mobile application. An IoT based application was developed, which can track down the position in real-time. The developed system is designed for user friendly equipment by simple one button service. Patient can simply press the button on the sensor device to report and send GPS location of emergency events. The location and other information will be displayed on the Web Map Application. EMS staff can easily know where patients are and make a plan to go to the patient location for rescuing. The main target of users for this system is aging people and disabled people who might not familiar with technology on mobile applications.

1. INTRODUCTION

The change in population structure has brought many countries into an aging society. Thailand Found the proportion of the elderly population in 2020, aged 60 years and over, more than 12 million people, or about 18% of the total population, and in 2021 will increase to 20% of the total population. Making Thai society into an aging society. Under the aging society, health issues are important to the health system as the elderly are a group of ailments. In which 95% of Thai elderly people have illnesses or health problems, as follows: hypertension 41%, diabetes 18%, disabled 6%, and bedridden 1% (Department of Health, 2013). Illness and chronic disease are also the leading causes of limitation or loss of the elderly's ability to care for

themselves. Leading to the occurrence of a condition elderly disability. As a result, the elderly have higher dependency needs. Currently, there are many channels of communication for EMS service incidents, for example, by telephone via number 1669, using the ThaiEMS 1669 application, Mobile Application 1669, and Application TTRS Video (call center for hearing and speech impaired), etc. The recipient of the incident is the Information Gathering and Dispatch center (IGDc) in each Province. The IGDc operates 24 hours. The staff at IGDc use GPS navigation from IGDc location as start point to go to location of patient based on the caller.

However, using telephones to report the location of an accident by the elderly might be difficult to explain and take a long time to communicate to locate the location. The cause of the whistleblower may not be able to control his or her consciousness. Telling the location of the accident point is not completely correct where the driver chooses a route and that delays reaching the patient's location. Due to this problem, patients might get rescue late and timely medical treatment. May cause death or impairment of organs affecting the inability to function normally. This can also make a mild injury or illness worsen. Therefore, these problems are important to find solutions for the elderly population to have easy and convenient access to EMS services. The use of Geographic Information Systems (GIS), Global Positional System (GPS) and Internet of Things (IoT) technology can be used to find the location of an accident.

IoT is an arrangement of interrelated computing gadgets, mechanical and digital machines, objects, animals or individuals that are given one kind of an identifier and the capacity to exchange information over a system without requiring human-to-human or human-to-PC communication. IoT is a new concept that has evolved from the convergence of wireless technologies. Wireless communication is the transfer of information or signal between two or more points that are not connected by an electrical conductor. IoT devices equipped with Wi-Fi allow machine-to-machine communication. The sensor and actuator can be set up in different places but they are working together over an internet network. Message Queuing Telemetry Transport (MQTT) is a messaging protocol designed for lightweight M2M communications and resource-constrained wireless connectivity. Features in MQTT such as an asynchronous communication model, low memory footprint for low network bandwidth applications, support for network disruptions with QOS features and low power consumption are key enablers for a reliable and low-latency two-way communication using wireless cellular Internet connectivity.

This research aims to develop a Smart Emergency Notification System with IoT (SENS-IoT) based sensors that display real-time location information of the patient's home. The study was created using the U-blox GPS module as a home locator. The location coordinates are processed by NodeMCU and alerts via MQTT and Line Notify are sent to the operator's mobile phone. The information will be displayed as a map with information of the home location via web application and mobile application.

2. METHEOLOGY

2.1 System design

Development of a SENS-IoT with specified location sensors to access emergency medical services with U-Blox GPS and Web GIS application. The working design is, when the patient presses a button, NodeMCU ESP8266 will send the location and information in JSON format via MQTT. The GPS location of the patient's house will send and take into account to the central database. GeoServer working as Web Map Service (WMS) displayed point data on the web application and mobile application. At the same time, will send an alarm to Line Notify of the officer's mobile phone. When staff got alarm information, he/she can easily find the location on Web Map Application. Patients and plans to go to the patient facility to save lives.

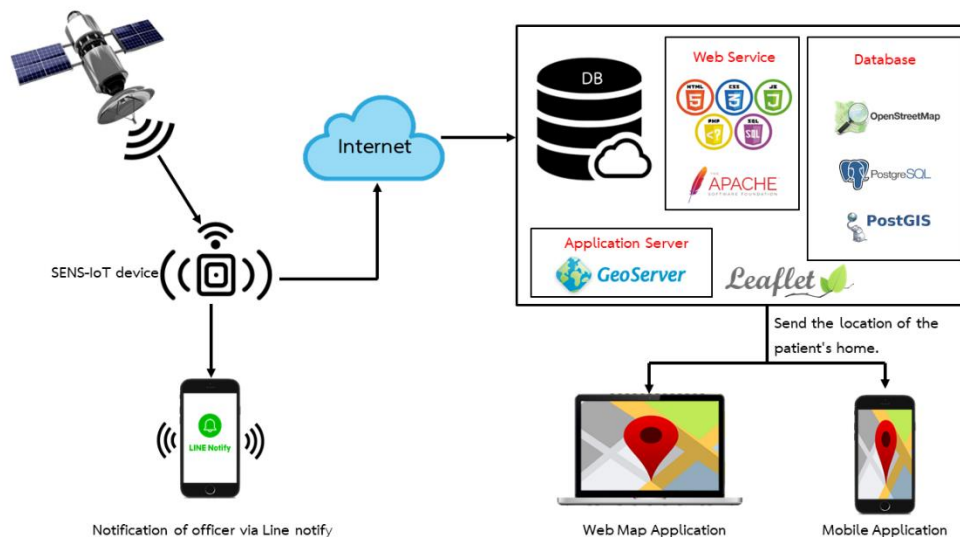


Figure 1 Research Conceptual Framework

3. SYSTEM DEVELOPMENT

In this research, the developers have used GPS U-blox 6m to determine the location of the area and use it. A NodeMCU ESP8266 microcontroller to connect to the Internet and send location data from U-blox to LINE Notify , MQTT servers and Database Server

3.1 u-blox 6 GPS Modules

The NEO-6 module series is a family of stand-alone GPS receivers featuring the high performance u-blox 6 positioning engine. These flexible and cost effective receivers offer numerous connectivity options in a miniature 16 x 12.2 x 2.4 mm package. Their compact

architecture and power and memory options make NEO-6 modules ideal for battery operated mobile devices with very strict cost and space constraints.

The 50-channel u-blox 6 positioning engine boasts a Time-To-First-Fix (TTFF) of under 1 second. The dedicated acquisition engine, with 2 million correlators, is capable of massive parallel time/frequency space searches, enabling it to find satellites instantly. Innovative design and technology suppresses jamming sources and mitigates multipath effects, giving NEO-6 GPS receivers excellent navigation performance even in the most challenging environments.



Figure 2 u-blox 6 GPS Modules

3.2 NodeMCU

The NodeMCU is an open-source firmware and development kit that helps you to prototype your IoT product with few Lua script lines. The Development Kit, based on ESP8266, integrates GPIO, PWM, IIC, 1-Wire and ADC all in one board. The ESP8266 is the name of a micro controller designed by Espressif Systems. The ESP8266 itself is a self-contained WiFi networking solution offering as a bridge from existing microcontroller to WiFi and is also capable of running self-contained applications. This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connect a NodeMCU device to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly. The MQTT library has been ported to the ESP8266 SoC platform and committed to the NodeMCU project. After this, the NodeMCU was able to support the MQTT IoT protocol using Lua to access the MQTT broker.

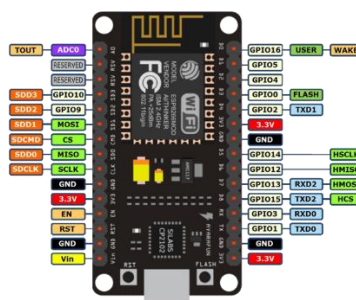


Figure 3 NodeMCU

3.3 Emergency button for the elderly with NodeMCU and GPS

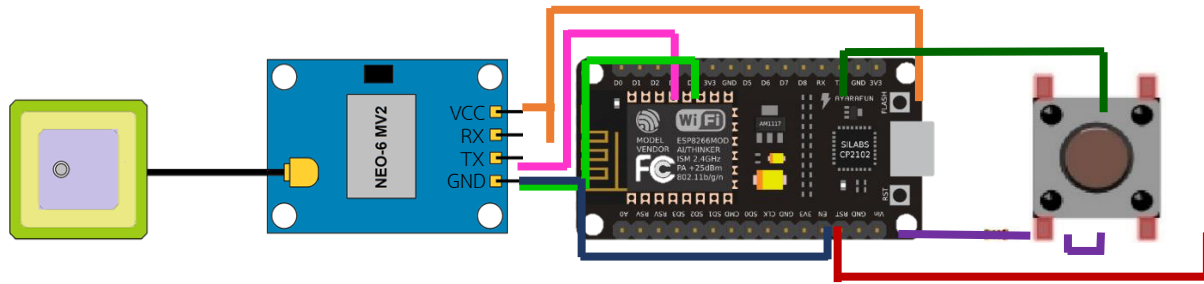


Figure 4 Emergency button for the elderly with NodeMCU and GPS

Connected the VCC and GND of the GPS module to the 3.3v and GND pins on the NodeMCU board, and connected the Tx of the GPS module to the D2 of the NodeMCU and Rx of the GPS module to D1 of the NodeMCU board. Connected one push switches by Connected the VCC and GND on the NodeMCU board and pin D8 of the NodeMCU board as connected button for press the emergency button.



Figure 5 Prototype System Circuit

3.4. MQTT

MQTT is a machine-to-machine / “Internet of Things” publisher-subscriber based connectivity protocol. It was designed as an extremely lightweight publish/subscribe messaging transport. It is useful for connections with remote locations where a small code footprint is required and network bandwidth is extremely expensive. Message Queueing Telemetry Transport is an ISO standard publish-subscribe based messaging protocol. It works on top of the TCP/IP protocol. The publish-subscribe based messaging pattern requires a message broker.

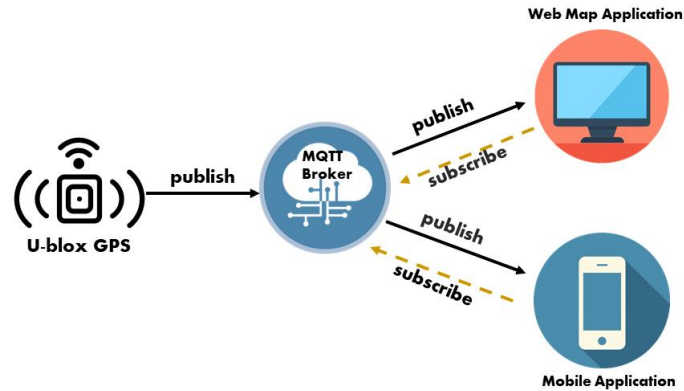


Figure 6 Message queuing telemetry transport protocol model

The left window shows a web application (GISci) displaying MQTT messages for the topic 'emsTracking'. The messages are JSON objects containing rescue information.

```

{"Need Rescue": "Somchai House", "Location here": ["16.7975506670", "100.1633956670"]}
qos : 0, retain : false, cmd : publish, dup : false, topic : emsTracking, messageld : , length : 95
  
```

The right window shows the Arduino IDE (EMS_gpstracking | Arduino 1.8.10) with the following code:

```

272
273 StaticJsonDocument<256> doc;
274 while (!mqttclient.connected()) {
275   Serial.print("Attempting MQTT connection...");
276   // Create a random client ID
277   String clientId = "ESP8266Client-";
278   clientId += String(random(0xffff), HEX);
279   // Attempt to connect
280   if (mqttclient.connect(clientId.c_str())) {
281     Serial.println("connected");
282     // Once connected, publish an announcement...
283     mqttclient.publish("EMS_Tracking", "How are you?");
284     // ... and resubscribe
285     mqttclient.subscribe("EMS_Tracking");
286   } else {
287     Serial.print("failed, rc=");
288     Serial.print(mqttclient.state());
289     Serial.println(" try again in 5 seconds");
290     // Wait 5 seconds before retrying
291     delay(5000);
292   }
293 }
294 doc["Need Rescue"] = "Somchai House";
295
296 JsonArray data = doc.createNestedArray("Location here");
297 data.add(u_lat);
298 data.add(u_lon);
299
300 char out[128];
301 int b = serializeJson(doc, out);
302
303 Serial.println(out);
304
305 boolean rc = mqttclient.publish("emsTracking", out);
  
```

Figure 7 Data Publish and Subscribe

4. RESULE

The location will sending an alarm message to LINE notify and send point data to Web Map Application when patient press the button on the device.

4.1 Notification of officer via Line notify

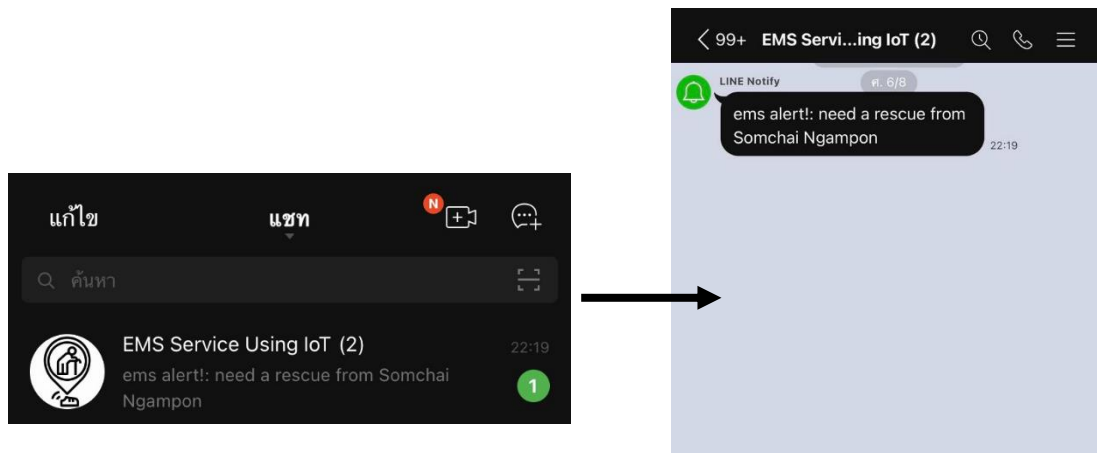


Figure 8 Line notify

4.2 Show the location of the patient's house via Web Map Application

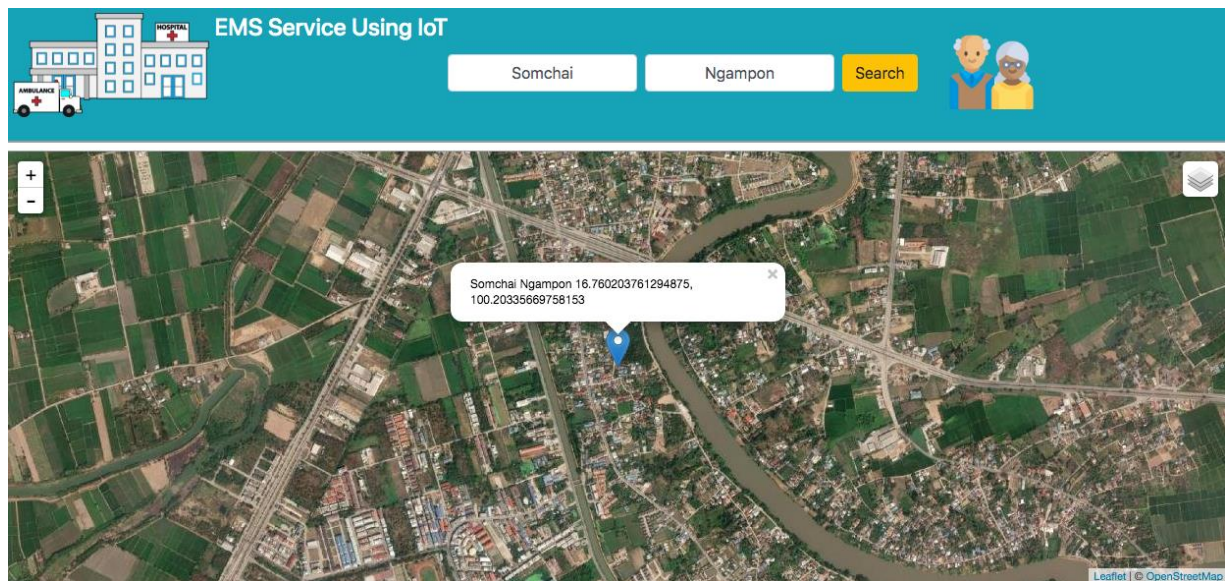


Figure 9 Web Map Application

5. DISCUSSION AND CONCLUSION

- Based on the results of the survey, the system using the U-blox neo 6m GPS module and NodeMCU can transmit the location of the patient's home effectively.
- The accuracy of the GPS module was around 10m outdoor and 25m indoor. These figures can be dramatically reduced by using a GPS module with a higher accuracy.
- Connecting the neo6 m GPS module to a satellite requires a considerable time of about 5 minutes, especially if the GPS module is in a confined space.
- IoT is a new internet application which leads to an era of smart technology where there exists thing-thing communication rather than human-human communication. Through IoT, each and every object in this world can be identified, connected and take decisions independently. It has taken its birth from mobile computing and ubiquitous computing. Technologies such as RFID, wireless sensor networks and embedded systems play a vital role in forming an IoT application. It is used in many applications in healthcare, agriculture, smart buildings, transportations etc.
- This work can be developed in conjunction with location search system and navigation systems. To help patients with pgRouting /OpenRouteService.

6. REFERENCE

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