Smart Integrating Digital Contact Tracing with IoMT for COVID-19 using RFID and GPS

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Abstract- In the present days, the tracking of COVID 19 affected person contact details will become a risky task. As per the research, symptoms for COVID 19 can be predicted only after 15 days. During this interval of 15 days, the corresponding affected person may have contacts with many persons which can't be predicted. To overcome the problem, this paper is focused to trace both home contacts and business contacts. The RFID fetches the details of the near contacts and stored in the cloud database (AWS). An Android application is designed to track the location of contact details through GPS. By selecting the patient RFID tag number, the application will show all the contacted person details for the past 15 days. This will be more useful to stop the spreading of virus by testing the contacted person in quick time. The temperature sensor helps in monitoring the person body temperature. If the temperature increases, the intimation of corresponding person details stored in the cloud. To transfer the data, MIMO (Multiple Input Multiple Output) wireless network is used.

Index Terms- RFID, AWS, GPS, MIMO

I. INTRODUCTION

This paper is focused to trace the contacted list with the COVID 19 affected person for the past 15 days. To monitor the temperature of the person, a wearable band which contains temperature sensor and RFID receiver will be provided for all public. The temperature sensor helps in predicting the current temperature of the person and RFID receiver helps in predicting the person within 2 meter. The wearable band connects with the Android mobile via Bluetooth. The app notifies the user to maintain a physical distance of 2 m (or 6 ft), which is a key factor in controlling virus spread by using RFID receiver. In addition, a AWS server act as an cloud to store all user data to consider the environmental risk and user health conditions to predict the risk of spreading infection in real time. The environmental risk conveys from the virtual zone concept and provides updated information for different places. This implementation of project helps in reducing the spread of virus among the public by tracing the COVID 19 affected person contacted details in smart manner which helps to stop spreading in initial time.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

The Internet of Things (IoT) as a network of sensors collecting data both locally and remotely has proved useful in the field of Electronic-Health (E-Health) management [1]. A combination of Body Area Networks (BANs) and field monitoring devices have allowed for the collection of patient vitals and the provision of track and trace services critical for pandemic management [2]. Locally based E-Health mechanisms can collect health information such as blood pressure, temperature, heart rate, etc. This information can be stored locally and accessed by a health care professional. Local systems can also be used to alert the patient when they need to consult medical personnel and when they need to take medication. Remote based E-Health is essential for health care providers in enabling remote access of patients and patient data. Patient vitals and location can be transmitted at regular intervals to nearby or distant medical facilities for monitoring purposes [3], [4].

Health workers and authorities need data to manage a rapidly spreading respiratory pandemic. For COVID-19, data can be used to start the diagnosis of infection and also trace the direction of spread in the community. Primary essential data required includes body temperature, location and travel history [8]. These parameters can alarm officials on whether there is a need for further investigation and testing or not [9]. Initially, health workers resorted to a manual method of measuring temperatures using infra-red thermometers and verbal questioning of people on their history and locations. This posed a risk to health workers due to the increased contact with potentially infected subjects. It had also become an increasingly difficult approach as infection rates reached millions.

In times of a global pandemic such as the 2019 coronavirus (COVID-19), it is critical that social distance guidelines are adhered to and patients are effectively tracked and traced [5]. These two aspects help significantly in controlling the spread of the virus worldwide. The ability of IoT services in providing remote data collection and monitoring of patients in quarantine has made it a critical aspect in fighting the spread of virus pandemics [6], [7].As the world battles the COVID-19 pandemic that has infected over 11 million people and caused over half a million deaths worldwide [14], there are increased efforts by researchers to find quick solutions towards the effective

management of the virus spread. Health-based IoT is increasingly becoming an implementation strategy of choice following WHO guidelines on social distancing and track/trace procedures for infections. Therefore, advancements, adaptations, and ultimately evolution of IoT infrastructure/frameworks for E-Health are expected

III. STUDIES AND FINDINGS

Failure in Initial Level Prediction Causes

Patient 31: How one patient turned Korea's coronavirus outbreak into an epidemic.

South Korea's coronavirus outbreak appeared to be contained as the number of confirmed infections stabilized at 30. Sensing a turning tide, many Seoul residents took off their surgical masks and resumed riding the subways and shopping at malls. Then, on February 17, a 31st case surfaced at a health clinic in Daegu, a city about 150 miles south of the capital where the vast majority of known infections were located. An unidentified 61-year-old woman, who lived there and occasionally commuted to Seoul, tested positive for the novel coronavirus.

It seemed like a standard case until public health authorities started tracing the patient's tracks. What they learned shocked them: the woman had, during the previous 10 days, attended two worship services with at least 1,000 other members of her secretive religious sect whose leader says the end of days is coming.

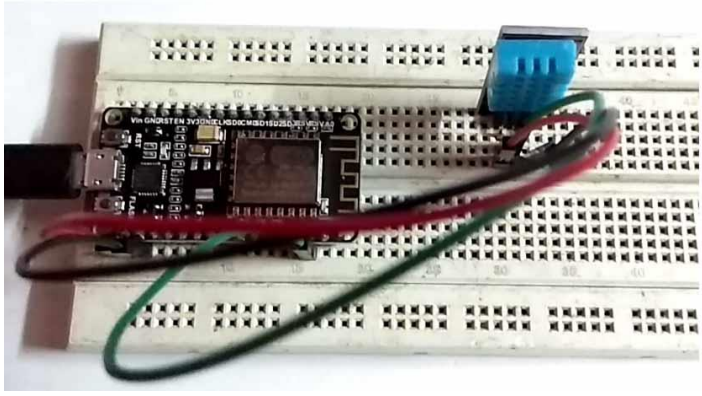
Within 24 hours, the nation's number of confirmed cases started multiplying exponentially. The tally rose by 20 during that period, doubled the following day and then doubled again on the third day. By February 20, the count skyrocketed past 1,000 more than 30-fold increase in a week that prompted the government to raise its health alert to the highest level. The group's emphasis on continually gathering for worship, recruitment and other activities may be the root cause of the cascading number of infections among Lee's disciples, said Stella Kang, a former sect member. At the two worship services attended by patient 31, more than 1,000 people sat on the floor, elbow to-elbow and knee-to-knee, for as long as two hours.

Implementation Steps

- Predict Temperature
- Store to AWS
- Trace Contacts using RFID
- Track Persons using GPS
- Keep Distance Alert

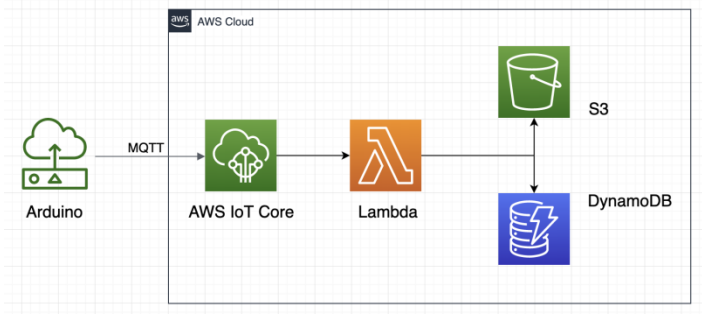
Predict Temperature (DHT11 Sensor Interfacing with NodeMCU)

DHT11 sensor measures and provides humidity and temperature values serially over a single wire. It can measure the relative humidity in percentage (20 to 90% RH) and temperature in degree Celsius in the range of 0 to 50°C.It has 4 pins; one of which is used for data communication in serial form. Pulses of different TON and TOFF are decoded as logic 1 or logic 0 or start pulse or end of the frame. The DHT11 sensor helps in monitoring the body temperature of the user which get captured by NodeMCU.



Capture and Store Temperature Data to Cloud

The temperature data can send data securely from NodeMCU to AWS IoT core using MQTT protocol. Hook lambda function with data and save it to DynamoDB or S3. We can analyze with AWS IoT analytics.AWS IOT stands for Amazon Web Service Internet of Things. This service allows us to connect our devices to the internet for processing, operating and exchanging data securely. Along with AWS IoT, the Amazon Web Services also provides tons of other features like virtual machine deployment, web-hosting, etc.



Steps in storing data to AWS through network

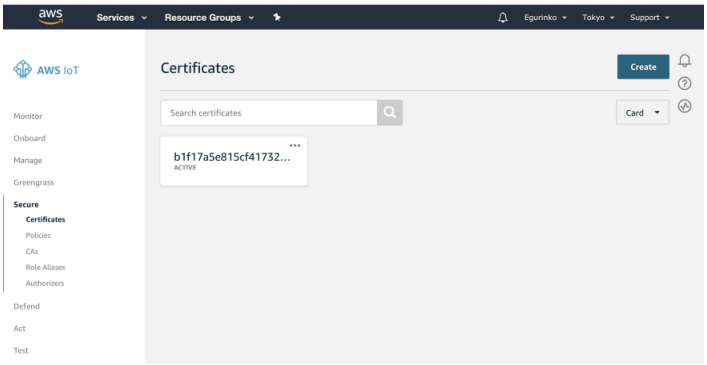
Step 1: Create a device certificate

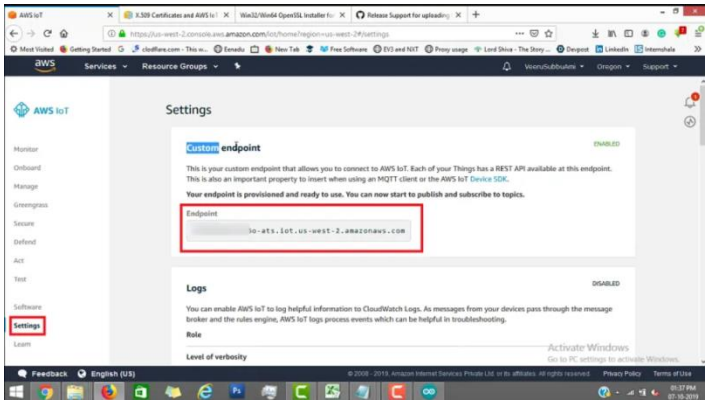
Step2: Create a sketch

Step3: Resultant temperature data in cloud

Create a device certificate

Login to the AWS Management Console & search for IoT core in the Amazon Services, Find services search bar will help you in this regard. After getting into the IoT Core section, tap on the tab called "Manage" from the AWS IoT menu which is on the left side, tap on the register thing button if you haven't added any devices till now.





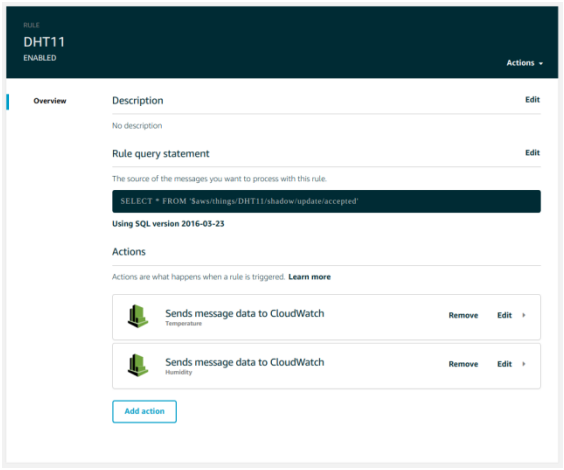
Resultant temperature data in AWS

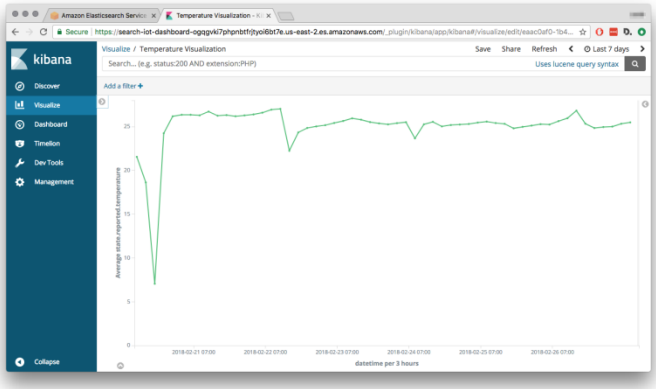
The device is now connected to your WiFi network, has authenticated itself with AWS, has the permissions to connect and publish to an IoT topic, and temperature data get uploaded towards the cloud.

Create a Sketch

After finishing setup for AWS IoT core. The pubsubclient library is used to connect NodeMCU and AWS IoT core using MQTT. Install NodeMCU ESP8266 filesystem uploader which packs the sketch data folder into the SPIFFS filesystem image, and uploads the image to ESP8266 flash memory.

- Download the tool archive"ESP8266FS-0.4.0.zip" from the Git hub releases page.
- In your NodeMCU sketchbook directory, create tools directory if it doesn't exist yet. You can find the location of your sketchbook directory in the NodeMCU IDE at File > Preferences > Sketchbook location.
- Unpack the tool into tools directory (the path will look like <sketchbook directory>/tools/ESP8266FS/tool/esp8266fs.jar).
- Restart NodeMCU IDE.
- Select "tools > ESP8266 Sketch Data Upload" will be there.



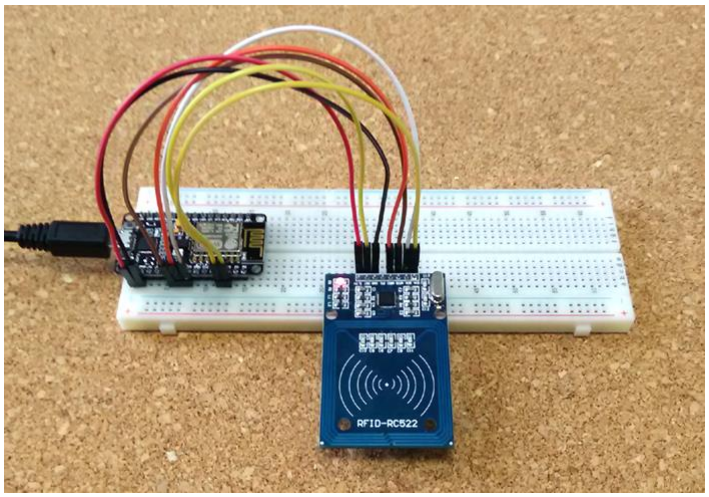


Trace Contacts using RFID

Radio-**F**requency **I**dentification (**RFID**) is the use of radio waves to read and capture information stored on a tag attached to an object. A tag can be read from up to several feet away and does not need to be within direct line-of-sight of the reader to be tracked. This is the advantage over Bar-code.

A **RFID reader** is a device used to gather information from an RFID tag, which is used to track individual objects. Radio waves are used to transfer data from the tag to a reader.

A **passive tag** is an RFID tag that does not contain a battery, the power is supplied by the reader. When radio waves from the reader are encountered by a passive rfid tag, the coiled antenna within the tag forms a magnetic field. The tag draws power from it, energizing the circuits in the tag.

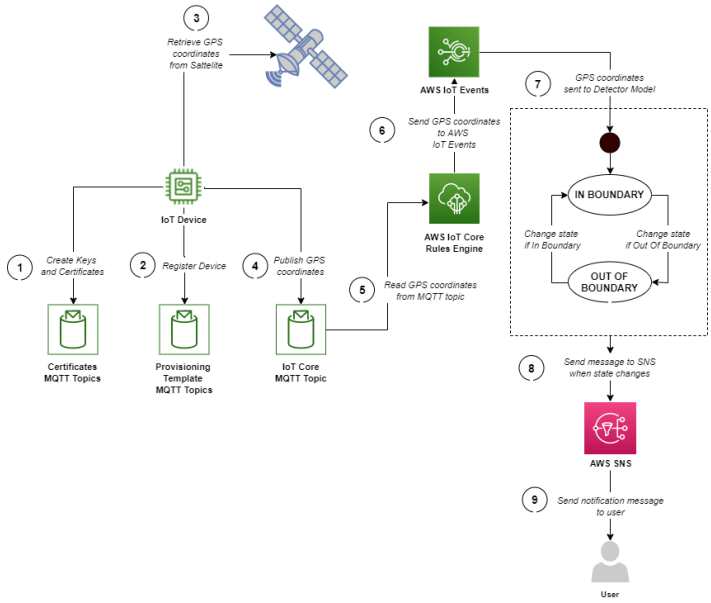


The Radio Frequency Identification (RFID) receiver gets attached with the user wireless band receives and store the near user RFID tag ID in the cloud. Each person has unique RFID tag id therefore tracing the person will become a simpler task. If the corresponding person affected with COVID 19, at that time those captured RFID tag id helps in finding the contacted persons for the past 15 days. This may reduce the spread of virus among the public.

Keep Distance Alert

The body temperature of the user gets predicted and thus the RFID helps the user to keep distance by analyzing the near user body temperature data. If the user reaches close within 2 meter, the device comes with an alert sound.

Track Contacted Person using GPS



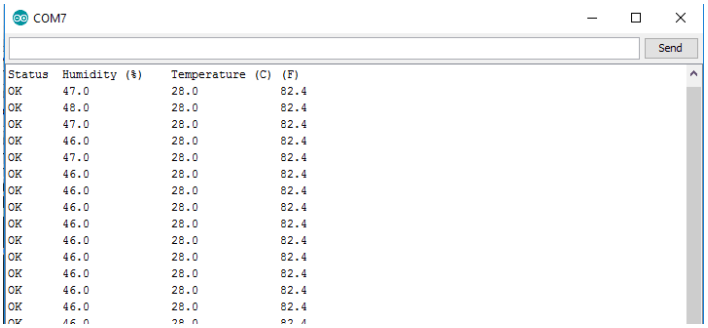
Steps in tracking contacted person

1. The device requests the creation of unique device credentials (create certificate and keys) to the AWS IoT Core service via a MQTT topic.
2. The device requests to register itself (activate unique device credentials) in the AWS IoT Core service via a MQTT topic, based on a provisioning template defined in the AWS IoT Core service.
3. The device retrieves GPS coordinates from a satellite.
4. The device publishes its GPS coordinates to the AWS IoT Core service over a MQTT topic.
5. The AWS IoT Core rules engine retrieves the GPS coordinates from the MQTT topic.
6. The AWS IoT Core rules engine sends the GPS coordinates to the AWS IoT Events service.
7. The AWS IoT Events service has a detector model that monitors incoming IoT events (GPS coordinates) to detect if a device is in its expected boundaries.
8. If a device state changes (either in boundary or out of boundary), the detector model sends a message to an Amazon Simple Notification Service (SNS) topic.
9. The end-users subscribed to the SNS topic receive a notification message to inform them of the device's state change.

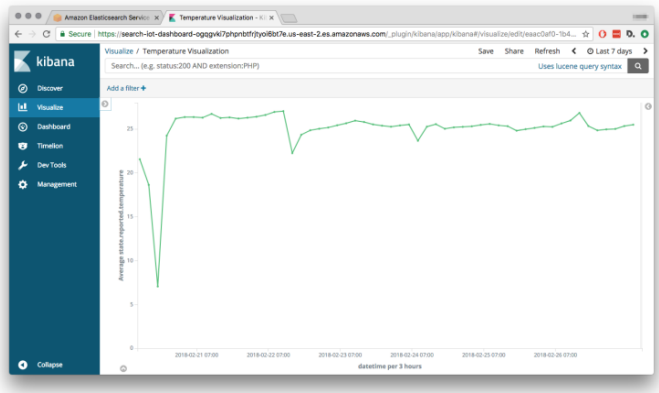
This implementation helps in tracking the contracted person location for the past 15 days with the COVID 19 affected person.

IV. RESULT

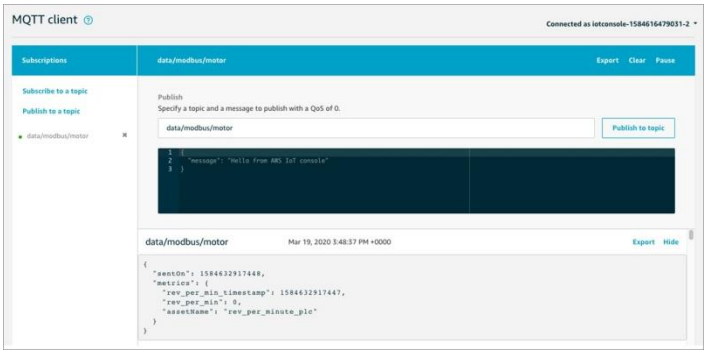
The captured temperature value of the users gets stored in the AWS cloud.



The temperature get visualized using kibana AWS tool to predict the number of person has temperature over the body level.



RFID Contacted Data Tracing



V. CONCLUSION

This implementation helps in collecting the contacted person details with the COVID 19 affected person for past 15 days in smart manner. The RFID tag helps in predicting the contacted person list. As a result the spreading of virus can be stopped by taking the test for the entire contacted person in initial stage. The current body temperature of the person is stored in the cloud which gets captured by all other wearable device. This data helps the user to give alert during the time of reaching near to the person having high temperature.

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