

Evaluate LoRaWAN-based IoT material for the Strategic Military surroundings

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ABSTRACT: The capability to recognize, speculate, reorganize and exploit the massive array of inter-networked things that will be present in the future defense field is critical for sustain and enlarge military competitive advantage. In this project, we present a proof of concept architecture for Internet of Things in military applications. The suggested architecture utilizes LoRaWAN (Long Range Low Power Wide Area Network). The architecture consists of PIR sensor, ultrasonic sensor, embedded micro controllers furnished with LoRaWAN compatible radio and a LoRaWAN gateway. The primary contributions of this project is estimating the presentation and suitability of the LoRaWAN for the military environment as well as inspecting the challenges of affiliating LoRaWAN based IoT devices into existing command and control systems within the military. The PIR sensor is an electronic sensor and it measures infrared light emitted from objects that generates heat and therefore infrared radiation, in the field of view and the range of detection is 5m to 12m. The ultrasonic sensor use a single transducer to send a pulse and to receive the echo and it measures the distance of target and distance range is 0.02m to 4m. The advent of IOT, which results in inexpensive commercial off the shelf, will give adversarial forces ever increasing capabilities that must be countered. Therefore the identification of the obstacles/human being can be detected by sensors.

KEYWORDS: Raspberry pi 3, LoRaWAN, PIR sensor, Ultrasonic sensor, Arduino controller

I. INTRODUCTION

In the future, defense field will be densely inhabited by various things, constituting miscellaneous mixture of actuators, sensors, analytics, information source, human and infrastructure with varying perception and capabilities and restriction on communications resources, energy, computing and power. The arrival of IoT, which results in bargain commercial off the shelf (COTS), will give adversarial forces ever enlarging potential that must be countered. In future, huge cities are anticipated to contain massive number of IoT devices. CISCO appraised that the connected device will reach up to 50 billion by 2020 [1]. This broad network of connected device will be very useful in military applications [2]. In the low power wide area network (LPWAN), networks are currently emerging as an impressive approach for IoT and contribute connectivity to various actuators and sensors. The objective of low power wide area network is to provide increased coverage scalability, energy efficiency and low cost for user devices [5].

This is opposed to commonly use cellular networks, which are focused on contributing high data rate and low inherent. Currently the suggested implementation for IoT can be classified into using commercial bands and ISM band.

In the commercial band, the occurring GSM/GPRS cellular foundation contributes low cost and good coverage. Further currently, the narrow band IoT network based on the LTE standard is introduced as different solution to GSM/GPRS [4]. It has been stated under 3GPP with the aim to offer IoT connectivity in a 200 spectrum, with in the LTE system [4].

On the other hand, the license free industrial, scientific and medical band can be used by anybody, but this band subject to internal and external impedance, opposed to the licensed biological scoped utilized by GPRS and narrow band IoT.

II. LoRaWAN PROTOCOL

The wide area network of the LoRaWAN protocol which is a media access control. It is used to communicate using network connection and designed to allow low powered devices in the application of over long range wireless connection. In the OSI model in which second and third layer is mapped using LoRa-WAN. In industrial, scientific and media radio bands in the modulation of FSK or LoRa on the top of implementation[3]. LoRaalliance which defines the LoRaWAN protocol and represented in the LoRa-WAN is established. It has three types of device in the LoRaWAN specification which are class A, class B and class C are increasing the establishment of device in class A. The communication between device and a gateway which support by using bi-direction in the device of class A. In the transmission of uplink at the specified time which opens in two receive window in the device. The receive window which doesn't represent the server and the device will be next chances to next transmission. In this server the first and second window of the receiver doesn't use in both windows. The higher range which comes from the low data rate and shorter range which from the higher data rate[5].

III.SYSTEM ARCHITECTURE AND IMPLEMENTATION

In the application of military this is proposed by architecture of IoT system. It consists of LoRa-WAN sensor and gateway in a connection in the bridge of SOI and which further connection to the strategic network in the part of section. It describes design and completion of the distractive block of our project model of IoT architecture.

Lora WAN nodes:

It has composed evolved and classified two main Lora nodes in the experiment and describes many prototypes. The test bed which were developed by LoRaWAN nodes. In the prototype the most productive in the terms of improvement, time, varying and en forced. It occupies the little space and has a working charge circuit in the power supply to a mobile battery using lithium.

IV.LoRaWAN GATEWAY

The protocol which based on LoRa technology for IoT devices and networks. In the smart devices the LoRa-WAN which need of complex local establishment and specification which provide inter operability. The design which based on star of network topology as the transparent gateway between the devices of end and a network server in the back end. The end devices are connected by the standard IP address through the gateway of the network server and to communicate with number of devices in the wireless network gateway. The end point which communicate in all point of bidirectional and also support group communication where the address to the group of destination[6].

The communication is spread out in various frequency range through the gateway of end devices in the given data rate. The frequency range and message timing in between the selection of data rate. The communication with several data rate due to the spread spectrum technology and doesn't interface either and to create a increasing the capacity of gateway which from 0.3 kbps to 50kbps in the LoRaWAN gateway. The network of the data rate output of the RF for each of end-devices separately by means of adaptive data rate.

V.INTEROPERABILITY WITH TACTICAL SYSTEM

One of the basic intension of the undertaking was to test the capability and ease of incorporating data from the Lora WAN network into existing and operational C2 systems. In this particular instance, the LoRaWAN network was incorporated into the Marine Corps Systems Command (MARCORSYSCOM) Tactical Service Oriented Architecture (TSOA). The SOI is primarily an information management system that supports publish/subscribe/query capabilities and allows a number of disparate systems to share information. In a real experiment, in which SOI is receiving LoRamessages[6]. For the intension of this observation, the Lora WAN data was published to a set of Federated Information Management Services realized by the SOIBridge.

This was accomplished by the custom NodeRED script described in the previous section, which parsed the

LoRaWAN packets converted the information into JSON format and transmitted it to the SOIBridge. Once the Lora WAN information was received at the SOIBridge, it was further translated into the specific message format used by septic C2 systems and shared amongst them according to the policies in force. It depicts a screenshot from the experiment, in which SOIBridge is receiving LoRa messages. Federation policies include Federation Acceptance Policies, Gate keeping Policies, Adaption Policies and Contract Policies. Federation acceptance policies determine if the information should be federated as well as what priority and resource privileges each federate should be given. Gate keeping policies determine how much access each federate is allowed to the information. Adaptation policies moderate how the federation will adapt when resource requests exceed network resource availability.

VI. PROPOSED SYSTEM

In proposed method we are using Lora WAN technology for distances. It is an example of ultra narrow band waveform that provides long range communication and low power requirements while trading off high bandwidth and typically operates in ISM band (868MHz) and does not require any licenses. Different coding and spreading factors are applied to derive specific data rate. The lowest data rate supports a band width of 980 bits/sec. The highest data rate supports a bandwidth of 21900bits/sec. The LoRaWAN which is free to use anywhere in the world. Lora devices consumed very little power making it ideal for battery powered devices. Coverage area about 5km in urban areas and 15km in suburban areas. Single Lora gateway device is designed to make care of 1000's of end devices or nodes. It is easy to display due to simple architecture. Figure 7.1 shows that LoRaWAN transmitter which transmits the data through the antenna to receiver. Figure 7.2 shows that LoRaWAN gateway which receives data to raspberry pi and finally analyze the process of the function.

VII. BLOCK DIAGRAM

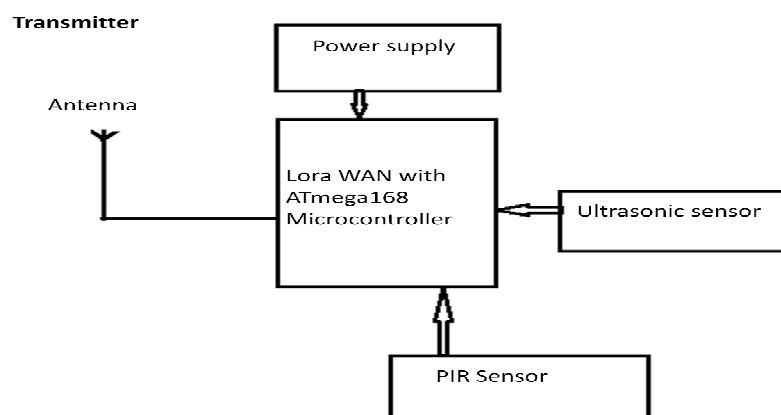


Fig 7.1: LoRaWAN Transmitter

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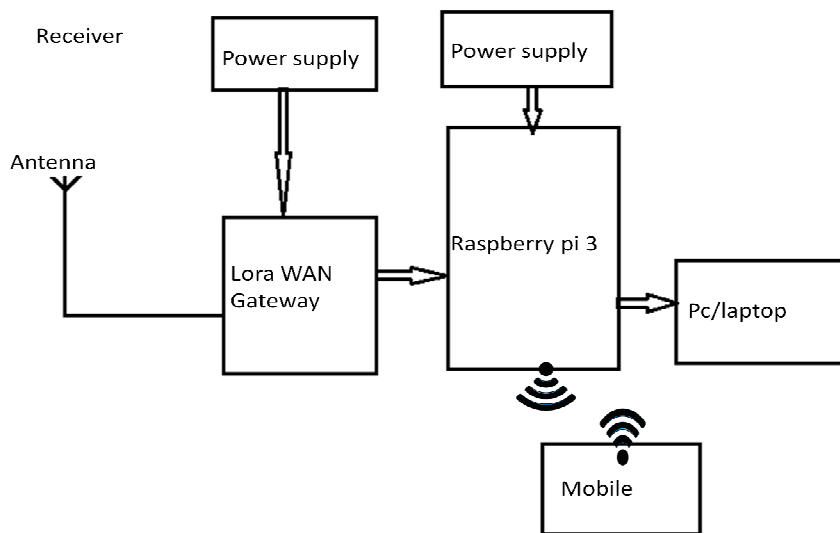


Fig 7.2: LoRaWAN Receiver

VIII. EXPERIMENTAL RESULT

We performed a range test and found the maximum range for the LoRaWAN board to be 6.1 miles. It depicts the GPS trace as we were testing the LoRaWAN nodes. We started the route from a location close to the LoRa gateway in the top center of the picture and drove counter clockwise as shown by the blue GPS trace. We lost the connectivity at a distance of 4.1kms on interstate. We believe the loss of connectivity is due to mountain ranges between the transmitter and the gateway. Connectivity was regained at a distance of 9.8kms which is designated with the yellow pin at the top right corner. Figure 8.1 shows that the Output of the sensor detection is given below.

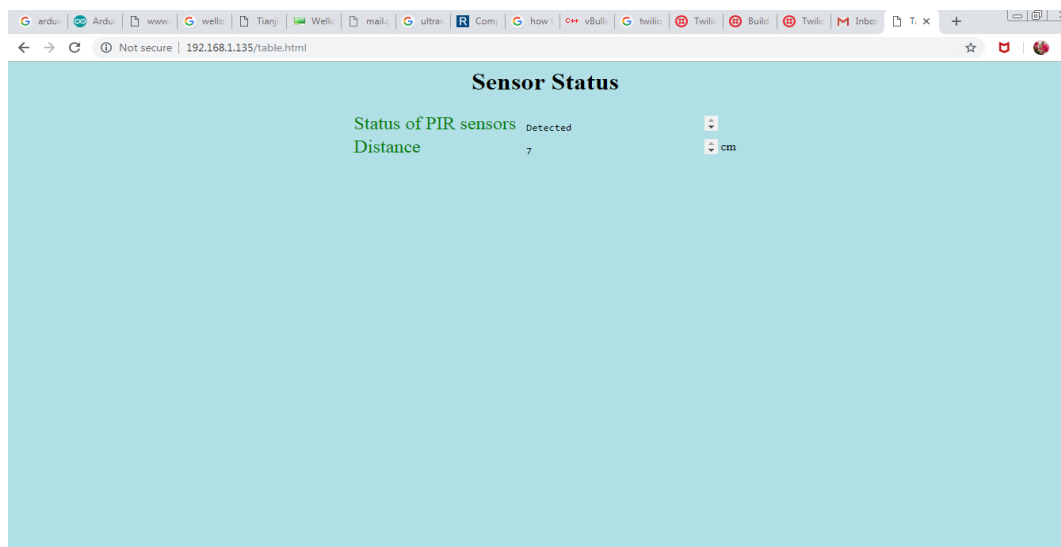


Fig 8.1: Sensor detection Output

IX.CONCLUSION

The system of LoRaWAN which consists of PIR Sensor, Ultrasonic sensor. The output of these sensors are analog in nature which is been converted to digital by configuring the ADC block registers in the LoRaWAN. The data is then passed to the LoRaWAN device and transmitted through the transmitted medium and receives the LoRaWAN gateway which evaluates the performance in terms of communication range. The range test demonstrated the LoRa is able to operate at up to distance of 9.8kms in the terrain where it was deployed. Finally the object or enemy is identified and the output detection of sensor is verified successfully.

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