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A Project Report

on

"Person Identification and Authentication based on LoRa"

Submitted in partial fulfilment of the requirements for the award of

BACHELOR OF ENGINEERING

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ELECTRONICS AND COMMUNICATION ENGINEERING

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CERTIFICATE

This is certified that the Project work entitled "Person Identification and Authentication based on LoRa" carried out by Mamatha M (1TJ18EC025), Manishankar S (1TJ18EC026), Rohith K (1TJ18EC033), Sanjay (1TJ18EC036) bonafide students of T. John Institute of Technology, Bangalore in partial fulfilment for the award of Bachelor of Engineering in Electronics and Communication Engineering of the Visvesvaraya Technological University, Belagavi during the year 2021-2022. It is certified that all corrections/suggestions indicated for internal Assessment have been incorporated in the report deposited in the department library. The Project report has been approved as it satisfies the academic requirement in respect of Project work prescribed for the said degree.

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DECLARATION

We, Ms. Mamatha M(1TJ18EC025), Mr. Manishankar S(1TJ18EC026), Mr. Rohith K (1TJ18EC033), Mr. Sanjay(1TJ18EC036) of final semester B.E Electronics and Communication Engineering, T. John Institute of Technology, Bangalore, hereby declare that the project entitled, "**Person Identification and Authentication based on LoRa**" embodies that the report of our project work done by us under the guidance of Ms. J. AARTHY SUGANTHI KANI, Asst. Prof. Dept. of Electronics and Communication, as particular fulfilment of the requirements for the award of Bachelor of Engineering in Electronics and Communication Engineering of the Visvesvaraya Technological Univesity, Belgaum during the year 2021-2022. Further, the matter embodied in the project has not been submitted previously by anybody for the reward of any degree.

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Sanjay

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The joy and satisfaction that accompany the successful completion of any task would be incomplete without thanking those who made it possible. We consider ourselves kind to be a part of T. John Institute of Technology, the institution which moulded us in all our endeavours. We would like to first express our sincere thanks to the almighty, to the coordinator **Ms. DRAKSHAYINI M N,** to the Principal **Dr. P. SURESH VENUGOPAL**, to the Vice Principal **Dr. H P. SRINIVASA** and **Prof. ANAND SWAMY A S,** Head of Department, Department of ECE, for their valuable guidance and encouragement throughout our program. We express our profound gratitude to the coordinators who have given valuable suggestions and guidance throughout the project. We would like to express our sincere gratitude to our guide **Ms. J. AARTHY SUGANTHI KANI**, Assistant Professor, for her guidance, continuous support and motivation in completing the project successfully.

Finally, we take this opportunity to extend our earnest gratitude and respect to our parents, teaching and non-teaching staff of the department, the library staff and all our friends who have directly or indirectly supported us.

Regards,

Mamatha M

Manishankar S

Rohith K

Sanjay

ABSTRACT

Multi-person tracking is affected by varies parameters such as crowd density, obstacle, range, etc. The LoRa technology is new but could provide a good range and efficiency for development of tracking system. Using LoRa technology, tracking and monitoring of individuals as well as selected users using their GPS location is done using their official assets. The collected data are used for further analysis with time stamp. Thus, this system is able to track and monitor the location of the person with real time accuracy.

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INTRODUCTION

CHAPTER 1

1. Introduction

In the present world, keeping track of every individual inside campus or organization is very time consuming and complex at times. And tracking multiple persons are affected by varies parameters such as crowd density, obstacle, range, etc. These varies parameters can cause a huge problem in accuracy of their location, identifying the correct user, etc, in general tracking of multiple persons. The person tracking is one of the typical applications in surveillance system for different kind of environments like industries, hospitals, educational institutions, etc. Human tracking in crowded scenes has multitude of users in real world. The evolution of wireless technology has provided the path to the revolution in tracking systems. One of such technology is LoRa (long range communication). It is also Low power wide Area Network modulation. LoRa uses spread spectrum modulation technic derived from chip spread spectrum (CCS) technology. LoRa has line of slight of more than 10 miles in the rural area and up to 3 miles in urban areas. In abstract we present a person identification and authentication based on LoRa, using LoRa technology, tracking and monitoring of individuals as well as selected users using their GPS location is done using their official assets. The location of the users or the location data is collected and stored in cloud. The collected data are used for further analysis with time stamp. Thus, this system is able to track and monitor the location of the person with real time accuracy.

1.1 Objective of the Proposed Project

- Person identification and authentication based on LoRa.
- The individual's movement is identified based on his/her GPS location inside the institution or infrastructure.
- This system aims to apprise the performance of the tracking system in rural and sub-rural areas.

1.2 Problem Statement

- Ensuring safety and security of the user has been one of the major concerns when inside an infrastructure.
- The data of the user (such as GPS location data) is managed and the data is made easy to be accessed by authorized administrator.
- Tracking of every single individual's presence inside the infrastructure and avoiding proxy attendance is possible.

LITERATURE SURVEY

CHAPTER 2

2. Literature Survey

[1] Student location tracking inside college infrastructure by N. Rewathi Sai Simha, B. N. Mohan Krishna, Dr. C. K. Gomathy, Dr. V. Geetha – 2020: In this paper, they have created a mobile application which records GPS information of students. GPS constantly records data of students. By starting this application, user is asked to register with their mobile number and password in login form. After logging in, the application will ask to select either view notice or fee details. if the user selects view notice, it will display the location of that particular student and also displays date. If the user selects fee details, then it will show fee details of that particular student.

[2] Tracking and monitoring system based on LoRA technology for lightweight boats by Ramon Sanchez Iborra, Christian, Simoes – 2018: This paper discusses about the Low power- wide Area Network (LP-WAN) to find lightweight boats. here, they have divided into 3 areas Radio Access Network, Cloud and User domain. LP-WAN helps in communication between ships and gateway in land. Gateway is contact point which forwards and receive data from cloud. Distributed network example: the internet delivers those data to central server. The processed data is used as useful information by user to accurately monitor the marine activities, including ships position, speed and other parameters.

[3] A LoRA- based linear network for location data in underground mining by Philip Branch, Bing Ham Li, Kai Zhao -2020: This paper, describes a LoRa based, linear sensor network we have developed for transmitting location information of personnel and equipment in an underground mine. Linear networks comprise a sequence of relays that forward data to a common destination, the headend. Relays forward location information transmitted from tags carried by personnel or equipment. Relays will usually be put in place as investigators or rescuers enter the mine. LoRa is used both by the tags to communicate to the relays and by the relays to forward messages to the headend.

[4] IOT based live student tracking system by Dr. K. Senathipalli, Rahul Gandhi- 2020: This paper discusses about “The IOT based live student tracking system” is a mobile application ensuring the safety and security of the students. The main objective of the application is to build a smart watch for school students. HC-05

[5] module is a wireless communication used in master or slave configuration. Unlike mobile phones, a Bluetooth modem doesn’t have a keypad and display to interact with. It just acknowledges certain orders through a sequential interface and recognizes for those. These commands are called as Serial commands. Which having the continuous data transaction to the application. If the application stops receive dummy values, then we will get alert in the application about missing the student.

[6] LoRA-Key: secure key generation system for lora-based network by Weitao Xu, Sanjay Jha, Wen Hu-2019: In this paper, we study the feasibility of physical layer key generation for LoRA network and propose an RSSI-based key generation system. LoRAkey employs a number of novel approaches to improve key agreement rate and key generation rate. LoRA-key can generate the same key for two legitimate LoRA nodes under different environments. Here, we can find the low data rate to low channel measurements reciprocity which makes the key generation significantly challenging.

[7] RFID based tracking system by Prof. Gaurav G. Narkhede, Akshay Kishor Langade, Kinal Gaurang Mehta, Shubhankar Abhay Kulkarni-2017: The main aim of this prototype is to track the official assets assigned to the authorized official of an organization so that important, valuable and confidential data should be safe. The input data is given to database. We query the database for the movements of the tags, and monitor the outward movement of the instrument/asset. The system alerts the administration or the malicious activity and then displays the updated movement table on the webpage.

[8] Person identification using multimodal biometrics under different challenges by Onsen Toygar, Esraa Alqaralleh, Ayman Afaneh-2017: The main objective of this paper is human identification and recognition in the field of human-robot interaction. The case of human-robot interaction that requires to use the unimodal biometric system. Two fusion methods for the multimodal biometric system will be presented and compared. The fusion of face and speech is an appropriate choice for human-robot interaction, since the enrollment phase of face and speech biometric systems doesn’t require contact with sensors. The face image or speech of a person is captured by a robot, even if the person is far away from the robot

[9] Animal health monitoring and intrusion detection system based on LoRAWAN by S Mohandas, S Sridevi and R Sathyabama-2021: In this paper, two important aspects of wildlife monitoring namely health monitoring and animal-vehicle collision (AVC) avoidance are addressed. In this paper, temperature sensor and heart rate sensors are used to monitor the health condition of elephants. An animal tracking system using GPS is provided for remotely monitoring animal position. Internet of things (IOT) technology is used to transmit the collected data from sensors to a remote station where the data are stored in the database

[10] LoRA radio frequency fingerprint identification based on frequency offset characteristics and optimized LoRAWAN access technology by Ning Chen, Hua Fu, Aiqun Hu- 2021: This paper mainly studies the radio frequency fingerprint technology based on Lora frequency offset characteristics. According to the extracted radio frequency fingerprint, the difference between different devices can be well represented. LORAWAN combined with LoRA radio frequency fingerprint identification technology, and proposes an optimized LoRAWAN access security mechanism which improves the access security performance of LORAWAN.

[11] Development of the LORAWAN based movement tracking system by Aznida Abu Bakar Sajak, Jasrina Jaffar, Ahmed Faeez Abdul Malic, Megat Farez Zuhairi- 2020: In this paper, they have used LORAWAN methodology. This project consists of Arduino microcontroller, dragino YUN shield and lora shield to operate as the lora gateway. Lora client requires Arduino microcontroller and GPS shield. GPS will be powered by lora client.

PROPOSED SYSTEM

CHAPTER 3

3. Proposed System

3.1 Block Diagram

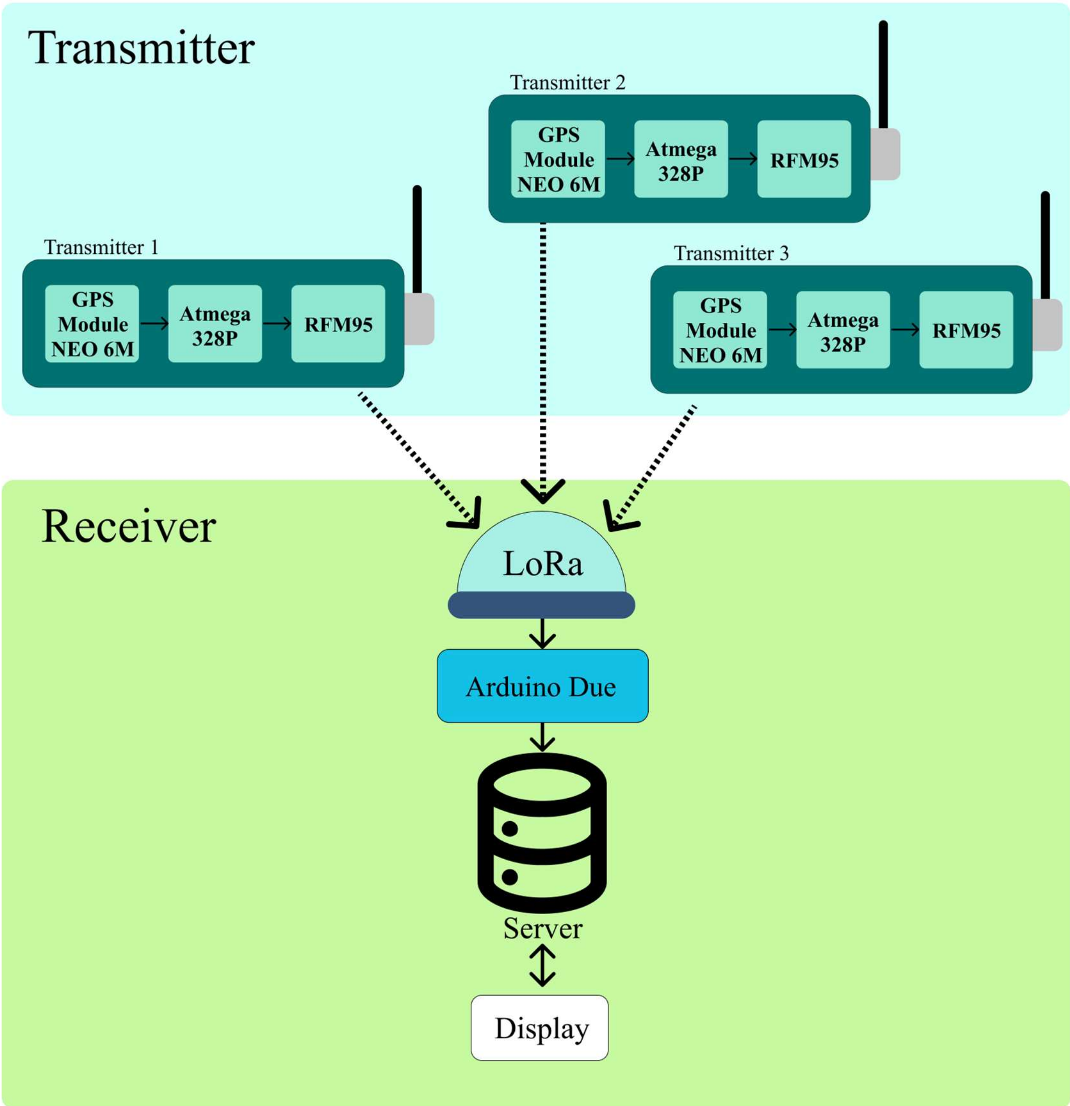

Figure 3.1: Proposed System Block Diagram

LoRA is a Long-Range wireless communication technology. It can accomplish data rates between 0.3 Kbit/s and 27 Kbit/s, contingent on the spreading factor. The frequency used in India is between 865 MHz to 867 MHz and can provide a range of communication up to five kilometres in urban areas and up to 15 kilometres or more in rural areas (line of sight). The person tracking is one of the typical applications in surveillance system for different kind of environments like industries, hospitals, educational institutions, etc. The evolution of wireless technology has provided the path to the revolution in tracking systems.

In this system the LoRa act as a receiver with range between 2 to 4 Km. The location information is gathered by the GPS module (NEO-6M), which has the parameters of latitude, longitude and altitude. The information gather is given to microcontroller (ATmega328P) which analyse the information and encodes the GPS location data with unique ID provided to the specific user is given to the transmitter that is RFM95 which transmits the data.

The LoRa which acts as a receiver, receives the signal and gives it to the microcontroller (ARM's Cortex M3). The microcontroller decodes the information and identifies the user based on the unique ID associated with the information and stores the received location of the user in the user's database server. The data is stored locally in the server which can be accessed using unique user ID and Password.

The information stored in server can be accessed by the authorized person using the access key. This access key is unique for each and every user. This means more security can be provided and no other user can access their data without the access key. The required information will be displayed as user name, latitude, longitude and the time.

COMPONENTS REQUIRED

CHAPTER 4

4. Component Required

4.1.1 Transmitter Part

4.1.1.1 GPS Module (Neo 6M)

Figure 4.1.1.1: GPS Module (Neo 6M)

The u-blox NEO-6M global positioning system (GPS) module, a very popular, cost effective, high-performance GPS module with a ceramic patch antenna, an on-board memory chip, and a backup battery that can be conveniently integrated with a broad range of microcontrollers. Nowadays, two NEO-6M GPS modules are very popular - the GYGPS6MV2 and the GY-GPSV3-NEO.

The u-blox NEO-6M GPS engine on these modules is quite a decent one, and it additionally has high sensitivity for indoor applications. Moreover, there's one MS621FE-viable battery powered battery for reinforcement and EEPROM for storing configuration settings. The module functions admirably with a DC input in the 3.3-to 5-V reach (because of its implicit voltage controller). The first circuit graph of the module, acquired from the web.

The GPS modules are based on the u-blox NEO-6M GPS engine. The type number of the NEO-6M is NEO-6M-0-001, and its ROM/FLASH variant is ROM 7.0.3 (PCN reference UBX-TN-11047-1). The NEO-6M module includes one configurable UART interface for serial communication, yet the default UART (TTL) baud rate here is 9,600. Because the GPS signal is right-hand circular-polarized (RHCP), the style of the GPS antenna will be different from the common whip antennas used for linear polarized signals. The most popular antenna type is the patch antenna. Patch antennas are flat, generally have a ceramic and metal body, and are mounted on a metal base plate. They are often cast in a housing. For more information about u-blox reference plans, see their site. Remember, the place of the antenna mounting is extremely crucial for optimal performance of the GPS beneficiary. When using the patch antenna, it should be situated parallel to the geographic horizon. The antenna should have full perspective on the sky, ensuring a direct line of sight with as many noticeable satellites as conceivable.

4.1.1.2 ATmega328P

Figure 4.1.1.2 ATmega328P

The Atmel® ATmega328P is a low-power CMOS 8-bit microcontroller based on the AVR® enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328P achieves throughputs approaching 1MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

The AVR® core combines a rich instruction set with 32 general purpose working registers. Every one of the 32 registers are directly associated with the arithmetic logic unit (ALU), permitting two autonomous registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code productive while accomplishing throughputs up to multiple times quicker than traditional CISC microcontrollers. The Atmel® ATmega328P gives the accompanying highlights: 32K bytes of in-framework programmable flash with read-while-write capacities, 1K bytes EEPROM, 2K bytes
SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three adaptable Timer/Counters with compare modes, internal and outside interrupts, a serial programmable USART, a byte oriented 2-wire serial interface, a SPI serial port, a 6-channel 10-cycle ADC (8 channels in TQFP and QFN/MLF bundles), a programmable

watchdog timer with internal oscillator, and five software selectable power saving modes. The inactive mode stops the CPU while permitting the SRAM, Timer/Counters, USART, 2wire serial interface, SPI port, and interrupt framework to keep working. The shutdown mode saves the register substance yet freezes the oscillator, handicapping any remaining chip capacities until the following interrupt or equipment reset. In power-save mode, the asynchronous timer keeps on running, permitting

The client to keep a timer base while the rest of the device is dozing. The ADC sound decrease mode stops the CPU and all I/O modules with the exception of asynchronous timer and ADC, to limit exchanging commotion during ADC changes. In reserve mode, the crystal/resonator oscillator is running while the rest of the device is dozing. This permits exceptionally quick beginning up joined with low power utilization. The device is made utilizing Atmel high density non-volatile memory technology. The on-chip ISP flash permits the program memory to be reconstructed in-framework through a SPI serial interface, by a regular non-volatile memory software engineer, or by an on-chip boot program running on the AVR core. The boot program can utilize any interface to download the application program in the application flash memory. Software in the boot flash area will keep on running while the application flash segment is refreshed, giving genuine read while-write activity. By joining an 8-digit RISC CPU with in-framework self-programmable flash on a solid chip, the Atmel ATmega328P is a powerful microcontroller that gives a profoundly adaptable and cost-effective solution to many embedded control applications.

4.1.1.3 RFM95 (Transceiver)

Figure 4.1.1.3: RFM TRANSRECEIVER

The RFM95 transceivers feature the LoRa™ long range modem that provides ultra-long range spread spectrum communication and high interference immunity whilst minimizing current consumption.

RFM95 Transceiver offers the same solution as the RFM95W-868S2

Using the patented LoRa™ modulation technique RFM95 can achieve a sensitivity of over -148dBm using a low-cost crystal and bill of materials. The high sensitivity combined with the integrated +20 dBm power amplifier yields industry leading link budget making it optimal for any application requiring range or robustness.

LoRa™ also provides significant advantages in both blocking and selectivity over conventional modulation techniques, solving the traditional design compromise between range, interference immunity, and energy consumption.

These devices also support high performance (G)FSK modes for systems including WMBus, IEEE802.15.4g. The RFM95 delivers exceptional phase noise, selectivity, receiver linearity, and IIP3 for significantly lower current consumption than competing devices.

Features:

- LoRa™ Modem.
- 168 dB maximum link budget.
- +20 dBm - 100 mW constant RF output vs. V supply.
- +14 dBm high-efficiency PA.
- Programmable bit rate up to 300 kbps.
- High sensitivity: down to -148 dBm.
- Bullet-proof front end: IIP3 = -12.5 dBm.
- Excellent blocking immunity.
- Low RX current of 10.3 mA, 200 mA register retention.
- Fully integrated synthesizer with a resolution of 61 Hz.
- FSK, GFSK, MSK, GMSK, LoRa™ and OOK modulation.
- Built-in bit synchronizer for clock recovery.
- Preamble detection.
- 127 dB Dynamic Range RSSI.
- Automatic RF Sense and CAD with ultra-fast AFC.
- Packet engine up to 256 bytes with

- Built-in temperature sensor and low battery indicator.
- Module Size：16*16mm

Applications:

- Automated Meter Reading.
- Home and Building Automation.
- Wireless Alarm and Security Systems.
- Industrial Monitoring and Control
- Long-range Irrigation Systems

4.1.2 Receiver Part

4.1.2.1 LoRa Module

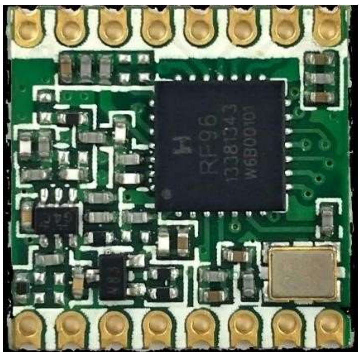

Figure 4.1.2.1: LoRa Module

LoRa utilizes sans license sub-gigahertz radio recurrence bands like EU433 (433.05-434.79 MHz) and EU863-870 (863-870/873 MHz) in Europe, AU915-928/AS923-1 (915-928 MHz) in Australia, US902-928 (902-928 MHz) in North America, IN865-867 (865-867 MHz) in India, AU915-928/AS923-1 and EU433 Southeast Asia and 2.4GHz worldwide.

LoRa empowers long-range transmissions with low power consumption. The innovation covers the physical layer, while different advances and conventions like LoRAWAN (Long Range Wide Area Network) cover the upper layers. It can accomplish data rates between 0.3 Kbit/s and 27 Kbit/s, contingent on the spreading factor.

LoRa gadgets have geolocation capacities utilized for trilateration positions of gadgets through timestamps from gateways.

LoRa utilizes a proprietary spread spectrum modulation that is like and a derivative of chirp spread spectrum (CSS) modulation. The spread spectrum LoRa modulation is performed by representing each bit of payload information by various chirps of information. The rate at which the spread information is sent is alluded to as the symbol rate, the ratio between the nominal symbol rate and chirp rate is the spreading factor (SF) and represents the number of symbols sent per bit of information.

LoRa can compromise data rate for awareness with a proper channel bandwidth by choosing how much spread utilized (a selectable radio boundary from 6 to 12). Lower SF implies more chirps are sent per second; henceforth, you can encode more data per second. Higher SF suggests less chirps per second; henceforth, there are less data to encode per second. Contrasted with lower SF, sending similar measure of data with higher SF needs more transmission time, known as airtime. More airtime implies that the modem is ready for action longer and consuming more energy. The advantage of high SF is that more extended airtime offers the beneficiary more chances to test the signal power, which brings about better sensitivity. The LoRa modem permits changing of the transmission power from 2dBm to 14dBm (433 MHz) or as high as 20dBm (865 MHz to 867 MHz, 915 MHz, and 923 MHz) according to the guidelines of every country. Higher transmission power gives the collector better signal power and better responsiveness, yet at the expense of consuming more energy. There are estimation investigations of LoRa performance as to energy utilization, correspondence distances, and medium access efficiency. According to the LoRa Development Portal, the reach given by LoRa can be up to three miles (five kilometres) in metropolitan regions, and up to 10 miles (15 kilometres) or more in country regions (line of sight). Also, LoRa utilizes forward error correction coding to improve resilience against interference. LoRa's high reach is described by high remote connection financial plans of around 155dB to 170 dB Range extenders for LoRa are called LoRaX.

4.1.2.2 Arduino Due

Figure 4.1.2.2: Arduino Due

The Arduino Due is a microcontroller board in light of the Atmel SAM3X8E ARM CortexM3 CPU. It is the principal Arduino board in light of a 32-digit ARM center microcontroller. It has 54 digital input/output pins (of which 12 can be utilized as PWM outputs), 12 analog inputs, 4 UARTs (hardware serial ports), an 84 MHz clock, a USB OTG capable connection, 2 DAC (digital to analog), 2 TWI, a power jack, a SPI header, a JTAG header, a reset button and an erase button.

The Arduino Due can be powered via the USB connector or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable.

The power pins are as follows:

- Vin. The input voltage to the Arduino board when it's using an external power source.

- 5V. This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V).

- 3V3. A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 800 mA. This regulator also provides the power supply to the SAM3X microcontroller.
- GND. Ground pins.
- IOREF. This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.
- Memory
- The SAM3X has 512 KB (2 blocks of 256 KB) of flash memory for storing code. The bootloader is pre burned in factory from Atmel and is stored in a dedicated ROM memory. The available SRAM is 96 KB in two contiguous bank of 64 KB and 32 KB. All the available memory (Flash, RAM and ROM) can be accessed directly as a flat addressing space.
- It is possible to erase the Flash memory of the SAM3X with the on board erase button. This will remove the currently loaded sketch from the MCU. To erase, press and hold the
- Erase button for a few seconds while the board is powered
- Input and Output
- Digital I/O: pins from 0 to 53
- Each of the 54 digital pins on the Due can be used as an input or output, using pin Mode (), digital Write (), and digital Read () functions.
- In addition, some pins have specialized functions:
- Serial: 0 (RX) and 1 (TX)
- Serial 1: 19 (RX) and 18 (TX)
- Serial 2: 17 (RX) and 16 (TX)
- Serial 3: 15 (RX) and 14 (TX)

- Used to receive (RX) and transmit (TX) TTL serial data (with 3.3 V level). Pins 0 and 1 are connected to the corresponding pins of the ATmega16U2 USB-to-TTL Serial chip.
- PWM: Pins 2 to 13 Provide 8-bit PWM output with the analog Write () function. the resolution of the PWM can be changed with the analog Write Resolution () function.
- SPI: SPI header (ICSP header on other Arduino boards)

These pins support SPI communication using the SPI library. The SPI header can be used only to communicate with other SPI devices, not for programming the SAM3X with the In Circuit-Serial-Programming technique. The SPI of the Due has also advanced features that can be used with the Extended SPI methods for Due.

- CAN: CANRX and CANTX
- These pins support the CAN communication protocol but are not yet supported by Arduino APIs.
- LED: 13 There is a built-in LED connected to digital pin 13. When the pin is HIGH, the LED is on, when the pin is LOW, it's off. It is also possible to dim the LED because the digital pin 13 is also a PWM output.
- TWI 1: 20 (SDA) and 21 (SCL)
- TWI 2: SDA1 and SCL1. It Support TWI communication using the Wire library. SDA1 and SCL1 can be controlled using the Wire1 class provided by the Wire library.
- Analog Inputs: pins from A0 to A11 the Due has 12 analog inputs, each of which can provide 12 bits of resolution (i.e., 4096 different values). By default, the resolution of the readings is set at 10 bits, for compatibility with other Arduino boards. It is possible to change the resolution of the ADC with analog Read Resolution (). The Due’s analog inputs pins measure from ground to a maximum value of 3.3V. Applying more than 3.3V on the due’s pins will damage the SAM3X chip. The analog Reference () function is ignored on the Due. The AREF pin is connected to the SAM3X analog reference pin through a resistor bridge. To use the AREF pin, resistor BR1 must be DE soldered from the PCB.

- DAC1 and DAC2 These pins provide true analog outputs with 12-bits resolution (4096 levels) with the analog Write () function. These pins can be used to create an audio output using the Audio library.
- AREF: - Reference voltage for the analog inputs. Used with analog Reference ().
- Reset: - Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

4.2 Software Requirements

4.2.1 Arduino IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. This software can be used with any Arduino board.

4.2.2 Microsoft Visual Studio

Microsoft Visual Studio is an integrated development environment(IDE) from Microsoft. It is used to develop computer programs as well as websites, web apps, web services and mobile apps. Visual Studio includes a code editor supporting IntelliSense (the code completion component) as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger. Other built-in tools include a code profiler, designer for building GUI applications, web designer, class designer, and database schema designer. Visual Studio supports 36 different programming languages and allows the code editor and debugger to support (to varying degrees) nearly any programming language, provided a language-specific service exists. Built-in languages include C, C++, C++/CLI, Visual Basic .NET, C#, F#, JavaScript, Type Script, XML, XSLT, HTML, and CSS. Support for other languages such as Python, Ruby, Node.js, and M among others is available via plug-ins. Java (and J#) were supported in the past.

WORK DONE

CHAPTER 5

WORK DONE

5.1 Transmitter Section

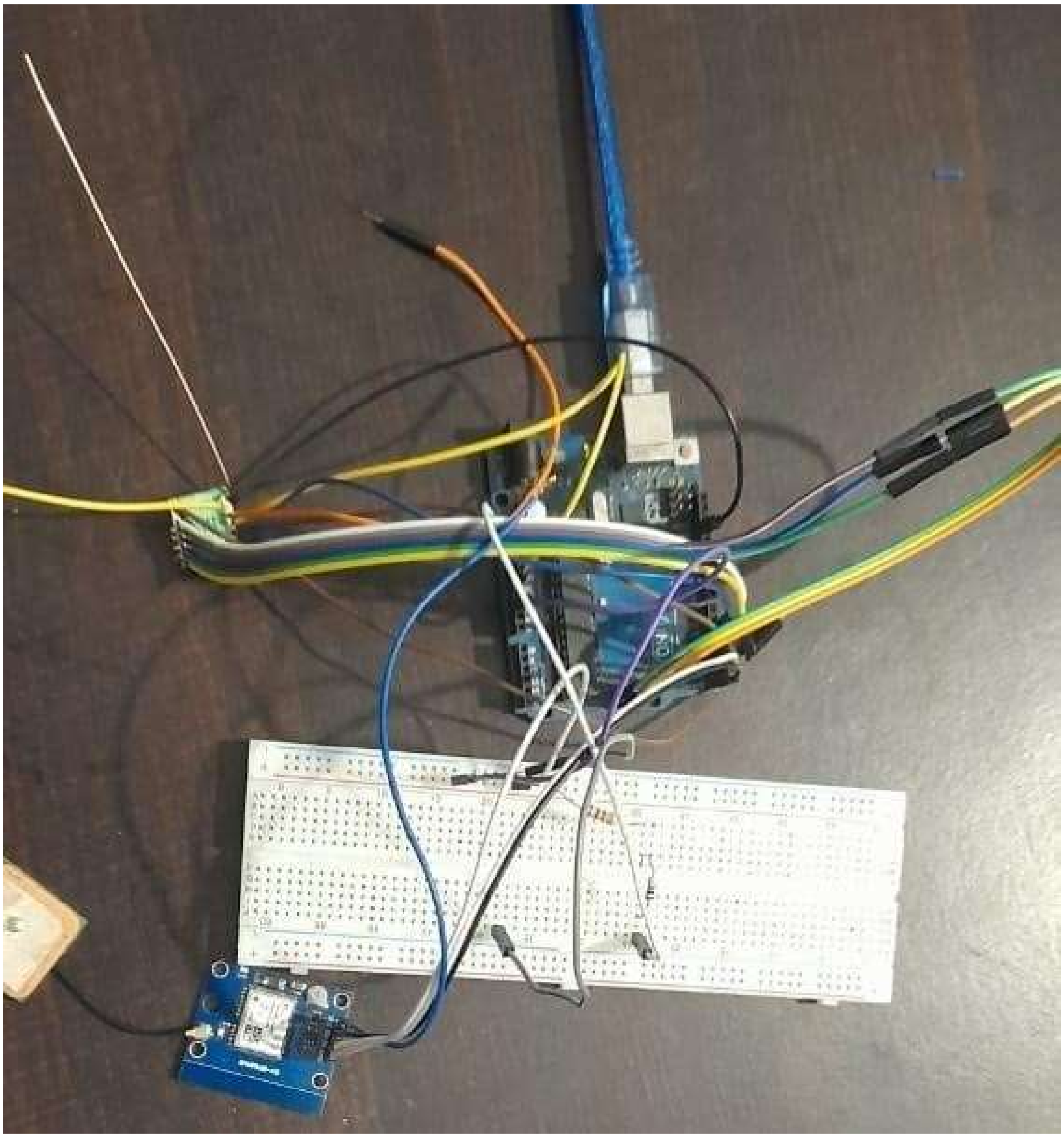

Figure 5.1.1: Transmitter Connection Section

The transmitter section consists of GPS module(Neo6M), Microcontroller(Atmega328p) and Transceiver (RFM TRANSRECEIVER). GPS receivers actually work by figuring out how far they are from a number of satellites. They are pre-programmed to know where the GPS satellites are at any given time. The satellites transmit information about their position and the current time in the form of radio signals towards the Earth. These signals identify the satellites and tell the receiver where they are located.

The receiver then calculates how far away each satellite is by figuring out how long it took for the signals to arrive. Once it has information on how far away at least three satellites are and where they are in space, it can pinpoint your location on Earth. This process is known as Trilateration.

The data which is to be transmitted is first encrypted at transmitter section and decrypted to access the data at receiver section. The encryption and decryption for the data transmission from RFM TRANSRECEIVER to LoRa is done based on RC4 method. RC4 is often referred to as ARCFOUR or ARC4 to avoid problems with RC4 trademarked name. The cipher is officially named after "Rivest Cipher 4" but the acronym RC is alternatively understood to stand for “Ron's Code”. The RC4 algorithm is designed especially to be used in software solutions because it only manipulates single bytes.

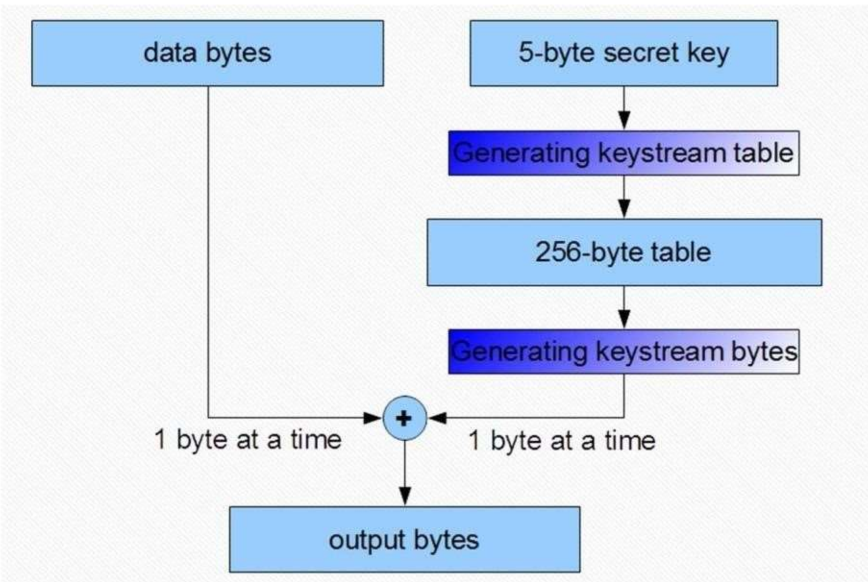

Figure: 5.1.2: Reference RC4 cipher model

The encryption and decryption process done in the project is based on RC4 Cipher model. The flowchart of encryption is as shown in the figure 5.1.2. The process occurring in the project is mostly bitwise XOR. The xor output is given to a transmitter in an array format (Header, Unique ID, Longitude, Latitude, Date, Time, Footer (along with CRC)).

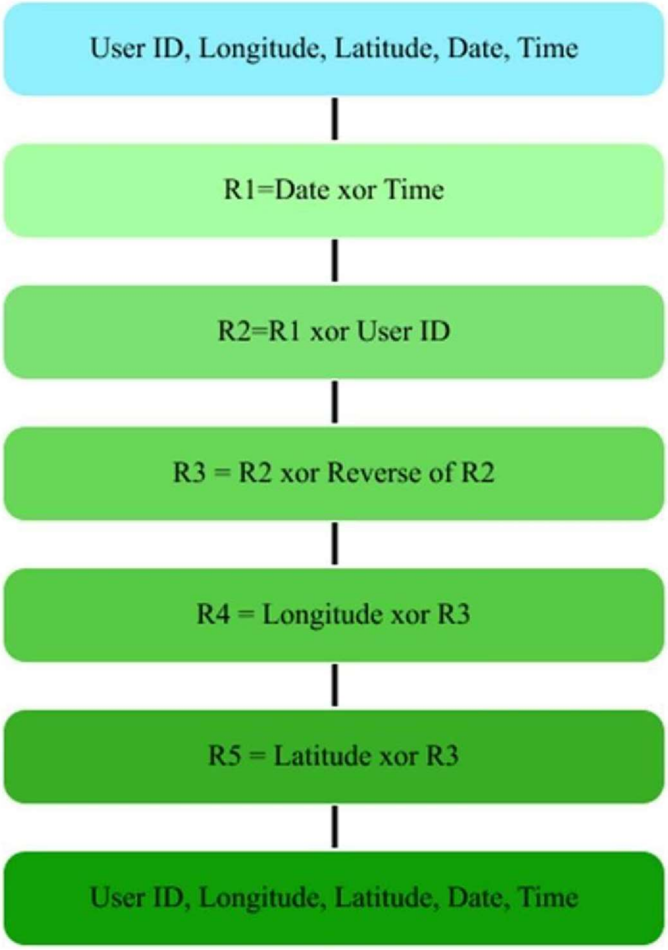

Figure 5.1.3: Flowchart of ciphering model

The Neo-6m GPS module is powered up and after few minutes (after cold start) it takes few seconds to connect to the satellite. The LED in the GPS module blinks indicating that the GPS module is connected or fixed the satellite. The GPS module needs to be connected to atleast 3 satellites to get latitude and longitude.

The longitude and latitude along the with time data is collected and is send to ATmega328p IC for encryption. The encrypted data is to the receiver using RFM95 module.

5.2 Receiver Section.

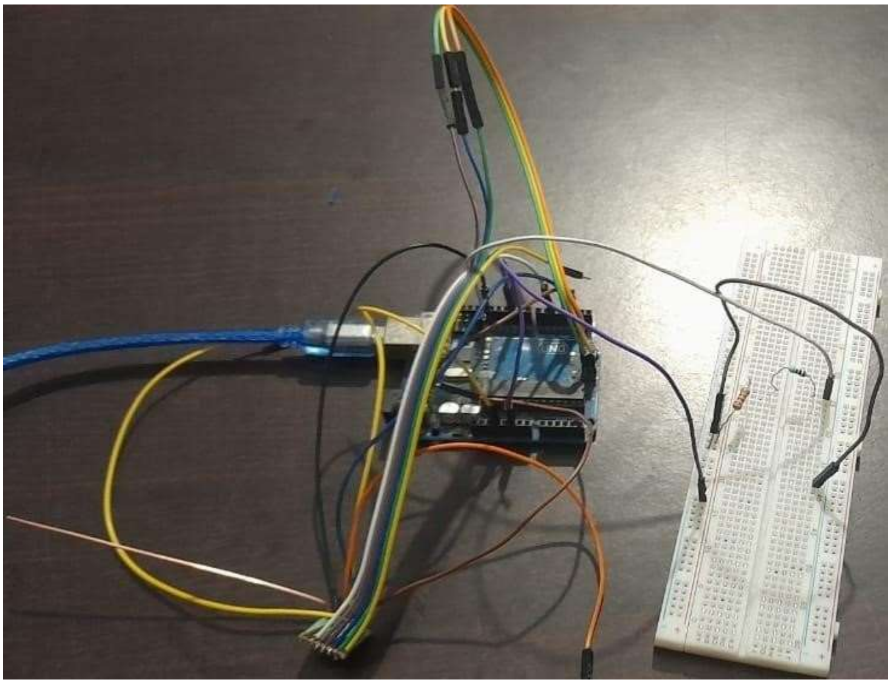

Figure 5.2.1: Receiver Section

The Receiver section consists of LoRA module, Microcontroller (Arduino Due), server. The data transmitted is received by LoRA first in the receiver section. LoRA (Long Range) is a transceiver which uses low power wide area network modulation technique. LoRA has a range of 2 to 5km in urban areas and 15km in suburban areas. The signal from one LoRA node travels to another node through a LoRA gateway. Network server gets signal from LoRA Gateway and sends it to the end-user through application server.

Decryption for the data transmission from RFM95 to LoRA is done based on RC4 method. The conversion of encrypted data into its original form is called decryption. It is generally reverse process of encryption. The main reason for encryption and decryption of data is for security purpose. As data travels over the internet, it is necessary to scrutinise the access from unauthorized organizations or individuals. Database is created in the receiver section for the easy access, management and updating of data.

Database are also used to improve business processes, keep track of individuals, store personal data. In this project the database is created locally. At the receiver the data that is collected is segregated and stored in the local server under specific user ID. To locate a specific user, that users' location data is retrieved, analysed and is represented on the map.

OUTPUT OF THE PROPOSED SYSTEM

CHAPTER 6

Output of the Proposed System

```
gpsdata.txt
Latitude= 12.740684 Longitude= 77.672637
Latitude= 12.740684 Longitude= 77.672637
Latitude= 12.740681 Longitude= 77.672645
Latitude= 12.740681 Longitude= 77.672645
Latitude= 12.740684 Longitude= 77.672645
Latitude= 12.740684 Longitude= 77.672645
Latitude= 12.740685 Longitude= 77.672645
Latitude= 12.740685 Longitude= 77.672645
Latitude= 12.740693 Longitude= 77.672645
Latitude= 12.740693 Longitude= 77.672645
Latitude= 12.740694 Longitude= 77.672645
Latitude= 12.740694 Longitude= 77.672645
Latitude= 12.740697 Longitude= 77.672637
Latitude= 12.740697 Longitude= 77.672637
Latitude= 12.740699 Longitude= 77.672645
Latitude= 12.740699 Longitude= 77.672645
Latitude= 12.740702 Longitude= 77.672637
Latitude= 12.740702 Longitude= 77.672637
Latitude= 12.740696 Longitude= 77.672637
Latitude= 12.740696 Longitude= 77.672637
Latitude= 12.740698 Longitude= 77.672637
Latitude= 12.740698 Longitude= 77.672637
Latitude= 12.740698 Longitude= 77.672637
Latitude= 12.740698 Longitude= 77.672637
Latitude= 12.740700 Longitude= 77.672645
Latitude= 12.740700 Longitude= 77.672645
Latitude= 12.740703 Longitude= 77.672645
Latitude= 12.740703 Longitude= 77.672645
Latitude= 12.740705 Longitude= 77.672645
Latitude= 12.740705 Longitude= 77.672645
Latitude= 12.740705 Longitude= 77.672645
Latitude= 12.740705 Longitude= 77.672645
Latitude= 12.740708 Longitude= 77.672645
Latitude= 12.740708 Longitude= 77.672645
Latitude= 12.740710 Longitude= 77.672645
Latitude= 12.740710 Longitude= 77.672645
Latitude= 12.740706 Longitude= 77.672645
```

Figure 6.1.1: Output from GPS module

The GPS location data that is the longitude and latitude including the user ID of the specific user is send from the transmitter section using RFM95. The data is then received by the receiver section of the RFM95. The GPS data is then stored in the local server.

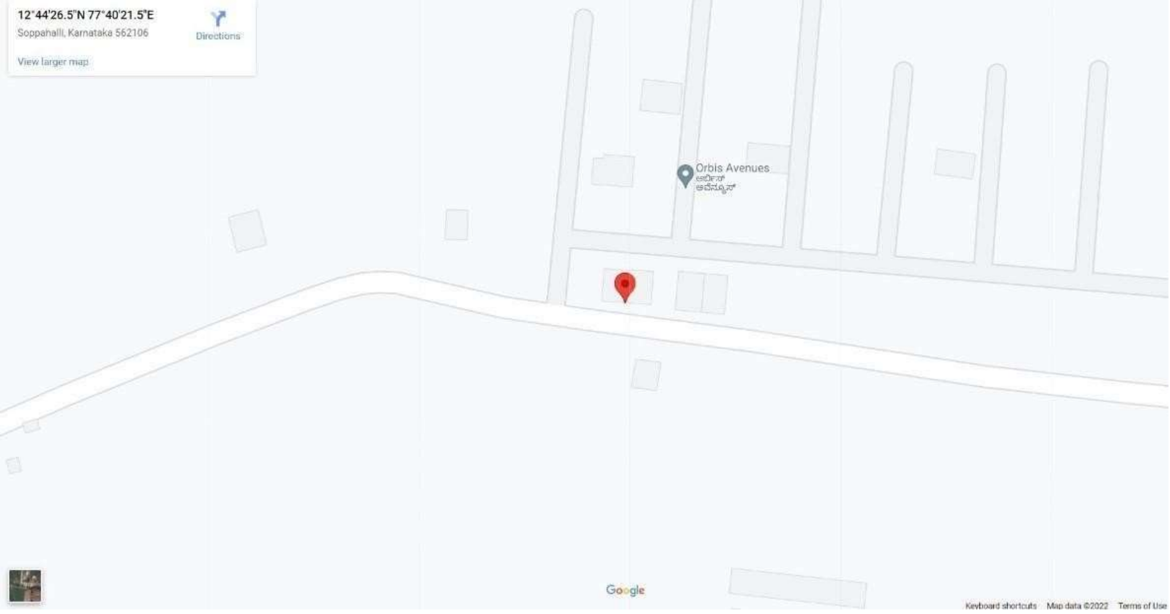

Figure 6.1.2: Representation of location data on Map

The output of the propose systems database is shown in figure 6.1.1. In the figure, it shows the longitude and latitude data of the specific user being received at the receiver end and the data is put into the database at the local server, where the data is then accessed and represented on the google map as shown in the figure 6.1.2. From the figure 6.1.2, the coordinate of the specific user is being displayed on the map.

ADVANTAGES AND APPLICATION

CHAPTER 7

7.1 Advantages

- It can be used in remote areas.
- It uses low power to transmit data over large distance.
- It enables low-cost connectivity.
- It is more efficient.
- No internet connectivity is required for communication.
- It provides a range of communication between 2 to 4 Kms.

7.2 Applications

- It can be used in wildlife sanctuaries.
- It can be used in colleges, enterprises and laboratories.
- It can be used in defence sector.
- It can be used for tracking single as well as multiuser.
- Monitoring of packages inside warehouse (Amazon, Flipkart, Big Basket warehouses).

CONCLUSION

CHAPTER 8

Conclusion

In this system we make use of LoRa technology to track the location of the person using GPS module and use this data to analyse the location within the given infrastructure to ensure the safety and security of the personal. The operation of the system where the transmission of GPS location data does not require the use of internet. The stored data is used to analyse and show the current location of the person within the infrastructure on the map. In this system we make use of Neo-6m GPS module to locate the user. The Neo-6m GPS module is connected to 4 or more satellite to get accurate coordinate of the user. The data is given to the ATmega328p where the data is analysed and encrypted. The encrypted data is send using RFM95 which is a transceiver. The encrypted data is send from transmitter side where the data is receiver

REFERENCE

CHAPTER 9

Reference

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[2] LoRa based linear sensor network for location data in underground mining in which they have placed sensors in linear network.

[3] IoT based live student tracking system uses Bluetooth for live tracking

[4] LoRa- Key: Secure Key generation system for LoRa based network uses RSSI-based key generation on system CS-based reconciliation approach.

[5] Person Identification using Multimodal Biometric under different challenges uses comparison between unimodal and multimodal system person identification.

[6] RFID based tracking system uses RFID technology to track the location of staff members.

[7] Design and Implementation of a GPS based personal tracking system uses GPS and GPS network to find location of a person

[8] GPS/LoRa based personal tracker works without mobile network their sim uses a GPS receiver to determine the location and the LoRa radio protocol to transmit the data to the control center.

[9] Personnel tracking with a GPS Real Time location system this was used to reduce help of dense Wi-Fi infrastructure as part of a hybrid RTLS for true site wide personnel tracking.

[10] LoRa radio frequency fingerprint identification based on frequency offset characteristics and optimized LoRaWAN access technology uses LoRaWAN technology to find the location.

ANNEXURE

Transmitter code:

```
#include <SPI.h>
#include <LoRa.h>
#include <TinyGPS++.h>
#include <SoftwareSerial.h>

static const int RXPin = 0, TXPin = 1;
static const uint32_t GPSBaud = 9600;
float Long=0;
float Lat=0;
// The TinyGPS++ object
TinyGPSPlus gps;
SoftwareSerial ss(RXPin, TXPin);
int counter = 0;
void setup() {
  Serial.begin(9600);
    ss.begin(GPSBaud);
  while (!Serial);
  Serial.println("LoRa Sender");
  if (!LoRa.begin(868E6)) {
    Serial.println("Starting LoRa failed!");
    while (1);
  }
}

void loop() {
  Serial.print("Sending packet: ");
  Serial.println(counter);
      //Long=gps.location.lat();
     // Lat=gps.location.lng();
  // send packet
```

```
 LoRa.beginPacket();
 LoRa.print("Lat: ");
 LoRa.print(gps.location.lat(),6);
 LoRa.print("c");
 LoRa.print("Long: ");
 LoRa.print(gps.location.lng(),6);
 LoRa.endPacket();
 delay(1000);
}
```

Receiver code:

```
#include <SPI.h>
#include <LoRa.h>

void setup() {
  Serial.begin(9600);
  while (!Serial);

  Serial.println("LoRa Receiver");

  if (!LoRa.begin(868E6)) {
    Serial.println("Starting LoRa failed!");
    while (1);
  }
}

void loop() {
  // try to parse packet
  int packetSize = LoRa.parsePacket();
  if (packetSize) {
    // received a packet
    Serial.print("Received packet '");

    // read packet
    while (LoRa.available()) {
      Serial.print((char)LoRa.read());
    }

    // print RSSI of packet
    Serial.print("' with RSSI ");
```

```
  Serial.println(LoRa.packetRssi());
 }
}
```

Server end code:

```
<?php
   $myfile = fopen("gpsdata.txt", "r") or die("Unable to open file!");
   $str = fread($myfile,filesize("gpsdata.txt"));
   $i = 0;
   $len = strlen($str);
   $n = strlen("Latitude= 12.740684 Longitude= 77.672637");
   $arr = [];
   while($i<$len){
    while($str[$i]!="\n"){
     $i++;
    }
    $data = substr($str,$i-$n,$n);
    $lat = substr($data,8,10);
    $long = substr($data,29,10);
    $a = array("lat"=>$lat,"long"=>$long);
    array_push($arr,$a);
    $i++;
   }
   fclose($myfile);
   ?>

<?php
 foreach ($arr as $key => $value) {

  $output = "<iframe height='480' frameborder='0' scrolling='no' marginheight='0'
marginwidth='0'
src='https://maps.google.com/maps?q=".$value["lat"].",".$value["long"]."+(Yarandahalli)
&z=19&output=embed'></iframe>";
  echo $output;
  echo $value["lat"];
  echo "<br>";
  // sleep(5);
  break;
 }
?>
```

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