

RSSI Indoor Positioning Integrated Classroom Attendance System

Submitted in fulfillment of the requirements for the award of
Bachelor of Engineering degree in Mechatronics

by

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**DEPARTMENT OF MECHATRONICS
SCHOOL OF MECHANICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Snekanth (39090051)** and **Bhargava Rao P (39090704)** who carried out the project entitled "**RSSI Indoor Positioning Integrated Classroom Attendance System**" Under our supervision from June 2022 to May 2023.

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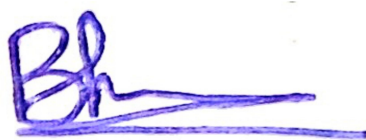
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DECLARATION

We **Snekanth (39090051)** and **Bhargava Rao P (39090704)** hereby declare that the project report entitled **“RSSI Indoor Positioning Integrated Classroom Attendance System”** Done by me under the guidance of **Dr.J.Senthilkumar,M.E.,Ph.D** is submitted in fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechatronics.

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ABSTRACT

Student attendance during classroom hours is important because it impacts the academic performance of students. Consequently, several universities impose a minimum attendance percentage criterion for students to be allowed to attend examinations; therefore, recording student attendance is a vital task. Conventional methods for recording student attendance in the classroom, such as roll-call and sign-in, are an inefficient use of instruction time and only increase teachers' workloads.

In this study, we propose an RSSI-based student positioning framework for automatically recording student attendance in classrooms. The proposed architecture consists of two components, an indoor positioning framework within the classroom and student attendance registration. Experimental studies using our method show that the Received Signal Strength Indicator technique that is used in indoor scenarios can achieve satisfactory positioning accuracy, even in a classroom environment with typically high signal interference.

We intentionally focused on designing a basic system with simple indoor devices based on RSSI technology and integrating an attendance system with computational techniques in order to minimize operational costs and complications.

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LIST OF ABBREVIATIONS

RSSI	Received Signal Strength Indication
TOA	Time of Arrival
TDOA	Time Difference of Arrival
RSS	Received Signal Strength
WSN	Wireless Sensor Networks
GPS	Global Positioning System
RFID	Radio Frequency Identification

CHAPTER 1

INTRODUCTION

We found that human location awareness still plays a role, even in very simple structures of houses, classrooms, and open ground. Issues with environment-aware infrastructures in wireless detection networks are the localization of objects (people, constant or changing particulars, or both). when considering sensor network applications. Many techniques have been proposed, but they continue to Recognize students individually or recognize their location still needs development.

the GPS-based technique is not always available in indoor settings like AC classrooms, auditorium and major complexity, power consumption, and cost performance constraints constantly exist. The GPS devices do not function in all environments (indoors and outdoors), in large city settings with tall buildings, or on densely forested routes since they depend on receiving a clean satellite signal. Objects such as walls, roofs, and other surfaces impede and disperse satellite signals.

Another classroom attendance system like radio frequency identification, or RFID, is a wireless technique for automatically recognizing and tracking tags or finding student activity. Its prominent uses include tracking and managing students, intelligent transportation systems, and contactless payment for the college canteen. An important drawback of RFID is the concerns around implementation. Systems based on barcodes and optical scanners have fewer material and capability requirements. Therefore, adopting and using this technology by individuals and smaller businesses could not be cost-effective. Although the technology has a wider range, physical obstacles can still restrict it. More particularly, readers may have trouble scanning through metallic and conductive items even while they can scan through non-metallic materials. In this research, we are developed freely roaming ID cards that we don't need to place an ID card (tag) on the n receiver node like RFID.

The scope of the project is that it focuses on a specific algorithm in the RSSI-based localization in classroom WSN. To perform this study and relevant analysis, initially, the simple part of the algorithm is implemented as a server application to analyse the results of the experiments.

The previous tracking system was done using the ultrasonic tracking system, where many ultrasonic sensors are to be used which led to an increase in cost for installation and was also labour intensive. This type of tracking is again a defective method as the precision is directly proportional to the number of sensors that is to be installed. Later, Laser range finders were developed as a powerful tool for finding a human with high precision, but the disadvantage of this arrangement is that it only covers small areas.

The latest study of this project focuses on RSSI-based localization, which is formulated by improving the precision of the localization algorithm, the results of experiments are evaluated time-to-time, and also the main effective parameter (Path-loss exponent and its relation with environmental condition) is considered. With its high accuracy and working ability, this system proves to be the best in the theoretical and simulation aspect. This system has limited battery consumption and a variation set of radii that determines the location of the students.

1.1 RECEIVED SIGNAL STRENGTH INDICATION (RSSI)

RSSI stands for Received Signal Strength Indicator, and it is a measurement of the signal strength between two communicating devices. In wireless communication systems, RSSI is used to determine the quality and strength of a signal that is received by a receiver from a transmitter. The RSSI value is usually measured in decibels (dBm) and is a relative indication of the received signal strength, with higher values indicating stronger signals. RSSI is useful for determining the range and reliability of wireless networks, as well as for aiding in location-based services such as indoor positioning. However, it is important to note that RSSI can be affected by numerous factors such as interference, obstacles, and environmental conditions, and should therefore be used in conjunction with other metrics to ensure accurate measurements. Received Signal Strength Indication (RSSI) is one of the most

commonly used characteristics for indoor localization. It is based on measuring the power present in a signal sent from an access point to a client device or vice-versa. As radio waves attenuate according to the inverse-square law, the distance can be approximated based on the relationship between the transmitted and received signal strengths as long as no other errors contribute to incorrect measurements. The combination of this information with a propagation model can help to determine the distance between the two devices. It can be assumed that as the number of available access points increases, a greater amount of information can be collected. Hence, the accuracy could be increased if relevant information is obtained. This, however, also works as a trade-off. An increase in the number of access points would increase the interference between different signals. A key challenge in wireless localization systems is that the range measurements are often associated with errors. RSSI techniques are among the cheapest and easiest methods to implement, but they do not provide the best accuracy. Filtering is necessary to improve system accuracy using RSSI-based localization. RSSI: is an indication that demonstrates the size of electromagnetic wave energy in a media (received by antenna in our sensor nodes) and the most wireless devices can measure received signal strength. Theoretically, RSSI is a function of distance and generally are affected by environment (and any changes in the environment). In the RSSI method, the unknown sensor node broadcast frames to the whole network and the other sensors in the communication area and then the distance calculates based on received RSSI values.

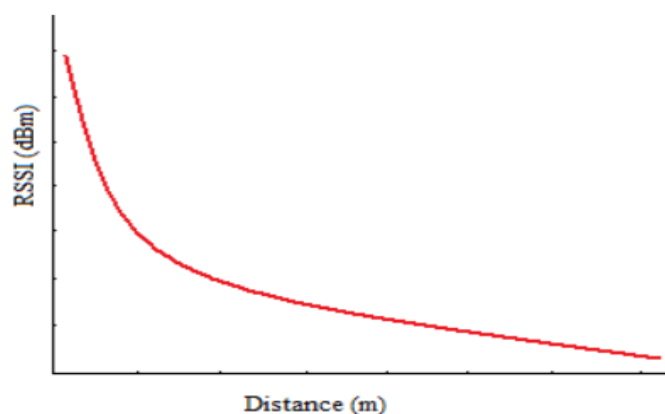


Fig: 1.1: Relationship between RSSI and distance

In the context of RSSI measurement method consideration of indoor or outdoor location tracking is important. Since, different location scenarios (indoor or outdoor) influence in path loss model (linear or non-linear), accuracy (in small indoor places is very considerable), space, deployment (find and put the anchors in strategic places to simplify estimation algorithm), map and transmission power (having minimum power for Link Quality Indicator in outdoor location is higher for the respect to quality of wireless communication. Also having a suitable power level is important in indoor location to avoid interference between anchor nodes)

1.1.1 RSSI Characteristics

To recognize the RSSI traits we ought to don't forget for sign propagation between transmitter and receiver and multipath fading effects. In reality electromagnetic waves pass in extraordinary paths of various duration and received in extraordinary time due to more than one reflection. The reflection is due to different objects and obstacles in an environment. The interaction of these waves causes multipath fading which affects the strength of the signal (decrease the strength) based on the distance between transmitter and receiver. Reflection, diffraction and scattering are the important concepts in signal propagation. Fading is divided into long-term fading and short-term fading. RSSI values are significantly affected by the location of experiment and multipath fading. In point of fact RSSI is environment dependent. Studies present that by a little change in the position, signals' waveforms are greatly different. It is because of changes in receiving distance, path and angel. Since multipath fading and changes in environment have the significant effects on RSSI values, even with a lot of attempts to maintain the environment unchanged, there is not any repeatability and regularity in the RSSI values. Therefore, and based on studies, in time and frequency domain RSSI signals are not periodic, RSSI signal variance is not directly related to its strength but both of them (variance and strength) are depended on environment condition. Figure illustrates the relationship between distance path loss and fading effect

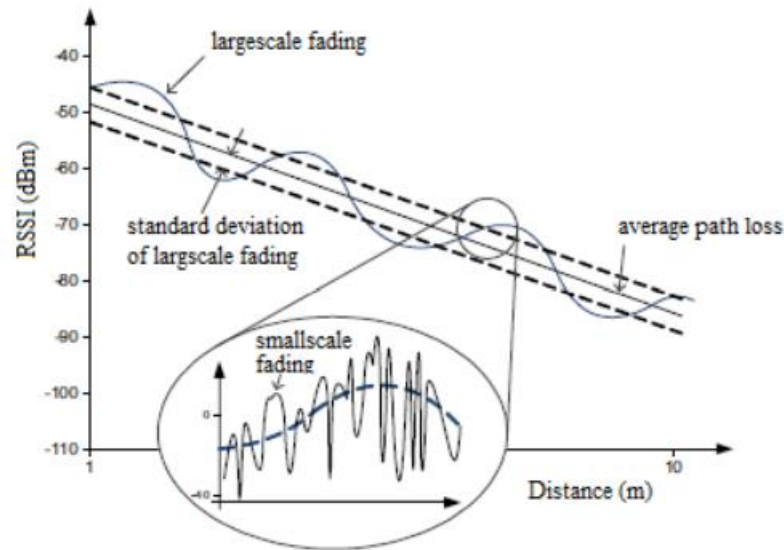


Fig: 1.2: Distance path loss and the effects of signal fading

1.1.2 RSSI Limitations and Challenges

RSSI (Received Signal Strength Indicator) is a measure of the power of a radio signal received by a wireless device, such as a WiFi or Bluetooth device. While RSSI can be useful for determining the proximity of a wireless device to a transmitter, there are several limitations and challenges associated with using RSSI as a measure of distance or location.

- **Signal interference:** RSSI can be affected by signal interference from other wireless devices or environmental factors, such as walls or other obstructions. This can result in inaccurate readings and make it difficult to determine the precise location of a wireless device.
- **Signal attenuation:** RSSI can be affected by signal attenuation, which occurs when a signal weakens as it travels through the air or through objects. This can make it difficult to accurately measure the distance between a wireless device and a transmitter.
- **Non-line-of-sight (NLOS) environments:** In NLOS environments, such as indoor spaces, RSSI readings can be highly variable and difficult to interpret. This can make it difficult to accurately determine the location of a wireless device.

- **Device heterogeneity:** Different wireless devices can have different RSSI values, even when they are located at the same distance from a transmitter. This can make it difficult to accurately compare RSSI readings across different types of devices.
- **Power consumption:** RSSI measurements require continuous radio signal monitoring, which can consume significant power, especially in battery-powered devices. This can limit the battery life of wireless devices and make continuous RSSI monitoring impractical.
- **Calibration:** RSSI values can vary depending on the specific wireless device and transmitter being used. This means that RSSI readings may need to be calibrated for each device and transmitter combination, which can be time-consuming and complex.

Effects such as path loss, fading, and shadowing have an impact on signal strength. Path loss is the decrease in signal strength that occurs while a signal travels through space. The "Path loss exponent (β)" illustrates this attenuation, and its value varies based on the environment. Tables 1 and 2 show various path loss exponent values and their relationships to standard deviation in various WSN environments.

Table: 1.1 : Path loss exponent (Beta value) variations in various environments

Environment	Path Loss Exponent
Free space	2
Urban area cellular radio	2.7 ~ 3.5
In-building LOS	1.6 ~ 1.8
Obstructed in-building	4~6
Shadowed urban area cellular radio	3~5

Table: 1.2: Standard deviation and beta value relationships in various environments

Environment	Path Loss Exponent	Standard Deviation
Free space	2	-
Retail store	2.2	8.7
Grocery store	1.8	5.7
Office, hard partitions	3	7
Office, soft partitions	2.6	14.1

A signal's attenuation deviates with fading, which is influenced by time, place, and radio frequency. Because fading is frequently taken into account as a random process, it may have positive or negative effects on the signal power at the receiver. One of the main causes of shadowing, which is the loss of signal between the transmitter and receiver due to various obstructions including walls, trees, buildings, and other things, is people moving around (up to a - 21 dB variation). As a distance metric, RSSI also has significant drawbacks. First, there is the RSSI-Distance ratio, which displays the RSSI values dispersed between minimum and maximum values for any distance, as well as the average RSSI-distance ratio on various platforms. The basis for this is that the deployment environment affects RSSI. In a bidirectional link, signal strength can also be asymmetric, which can boost received power. It indicates that in a link between sensor nodes A and B, there are more packets from A that are received by B than there are from B that are received by A. Even though the RSSIs are almost same, the variation in the number of received packets indicates that the link quality is not symmetric. Thirdly, according to some research, asymmetric and unidirectional aspects in RSSI values might be caused by anisotropic radiation behaviour. The term "isotropic radiation" refers to an antenna that transmits power equally in all directions and has the same intensity regardless of the direction of the measurement. Fourthly, there is a dynamic in the RSSI stability of the linkages. In actuality, we can see various tendencies in the RSSI stability in various WSN environment.

Despite these limitations and challenges, RSSI can still be a useful tool for proximity detection and location estimation in wireless networks. However, it is important to be aware of the potential sources of error and to use other methods, such as triangulation or time-of-flight (ToF) measurements, to confirm RSSI-based distance or location estimates.

1.2 WIRELESS SENSOR NETWORK (WSNs)

A Wireless Sensor Network (WSN) is generally defined as a collection of sensor nodes that communicate through wireless links. Each node in the network is equipped with sensors, a microprocessor, and a wireless transceiver. These networks can be used to monitor and analyze various physical phenomena such as temperature, humidity, light intensity, sound, motion, and pressure. WSNs have the capability to act as a bridge between the physical and digital worlds. They are deployed in a wide range of applications, such as environmental monitoring, structural health monitoring, military surveillance, industrial control, and many others.

The functioning of a WSN is based on the principle of distributed sensing, which means that each individual sensor node senses a parameter and can transmit the information wirelessly to a nearby base station. The base station will then process this information and selectively disseminate it to a designated end-user. The communication between sensor nodes in a WSN is typically done through a variety of wireless technologies, such as ZigBee, Bluetooth, Wi-Fi, and others. The choice of wireless technology depends on the application requirements, including the amount of data to be transmitted, the distance between the sensor nodes, and the power consumption of the nodes. The sensor nodes are typically battery-powered, and their power consumption needs to be carefully managed. This means that efficient power management strategies need to be employed to ensure that the sensor nodes can operate for extended periods without requiring a battery replacement.

In recent years, the use of machine learning algorithms and artificial intelligence has become increasingly popular in wireless sensor networks. These techniques can be used to analyze large amounts of data generated by the sensors and extract valuable insights that can aid in the decision-making process.

In the recent years, a great improvement in wireless communication, sensing technology and micro sensors, embedded systems and relevant software has been attained. Considering these advances, low complexity networks like Wireless Sensor Networks (WSN) have a wide range of application in surveillance and monitoring. Most of the devices or nodes in wireless sensor network are made up of off-the-shelf materials and deployed in the area of surveillance and monitoring. WSN is developed by some battery-powered and inexpensive sensors (usually setup randomly), embedded system, wireless communication systems and multi-processors with self-organizing characteristics which can communicate, collect, process, store and transfer data of specific sensor nodes (SN) in a region. Collecting data of an object (SN) in an indoor environment is a basis of finding the position of it. Therefore, estimating the location of a moving object (sensor) is the main requirement for wireless sensor networks applications. Using GPS for an ad-hoc network with lots of sensors isn't always feasible since, one of a kind obstacles can block the line-of-sight signals, power intake of GPS decreases life of the network, In those types of networks (with plenty of sensors) making use of GPS is high priced and finally, Sensors want to be small however the usage of GPS equipment will increase the scale of sensors. In the WSNs localization we've got a hard and fast of sensors a one of sensor (node) which is fixed and the rest of them have unknown positions that we want to find (X, Y, Z coordinates) with the help of the other known-position sensors. Node localization answers estimate the region of a transferring object (unknown sensor) primarily based totally on anchors with acknowledged region. These nodes (anchors) are receivers of the alerts which are transmitted from transferring objects (in a few protocols anchors are transmitters). In accordance with a few protocols, the power, perspective and time of the transmitted sign may be used to estimate the space among sensors and anchors. WSN packages take into account energy, price and length of nodes, so it's far applied in large-scale systems for lengthy time.

In conclusion, WSNs have revolutionized the way sensing and monitoring are done. They offer an efficient and scalable solution for remote monitoring of physical systems. With the advent of new technologies and techniques, the capabilities of WSNs are expected to grow in the future, leading to new areas of research and applications.

1.3 DIFFERENT NETWORK MANAGEMENT APPROACHES IN RSSI

RSSI (Received Signal Strength Indicator) is a measure of the strength of a wireless signal in a network. It is important for the management of wireless networks since it helps in determining the range and coverage of the network. There are different approaches to managing RSSI in a network, some of which are:

- **Dynamic Management:** Dynamic Management involves setting the RSSI thresholds dynamically based on the signal strengths observed in a network. This approach is useful in environments with fluctuating signal strengths due to interference or other factors. Dynamic management adjusts the threshold values automatically to maintain optimal network performance.
- **Static Management:** Static Management involves setting static RSSI thresholds that remain constant regardless of signal strength variations. This approach is useful in environments with stable signal strengths where the threshold values can be set accurately for optimal network performance.
- **Hybrid Management:** Hybrid Management combines both dynamic and static management approaches to manage RSSI in a network. This approach is useful in environments with both stable and fluctuating signal strengths where dynamic management adjusts the thresholds for fluctuations while static management sets ideal threshold values for the stable areas.
- **Adaptive Management:** Adaptive Management involves using machine learning algorithms to determine the optimum RSSI thresholds for a network. It is useful in environments with unpredictable signal strengths that do not follow any particular pattern.

- **Zone-based Management:** Zone-based Management involves dividing a network into zones based on signal strength. Different RSSI thresholds are set for each zone to optimize network performance. This approach is useful in large networks with varying signal strengths across different zones.

In conclusion, selecting the appropriate RSSI management technique depends on the type of environment, signal strength nature, and overall network requirements.

1.4 DIFFERENT NETWORK MANAGEMENT APPROACHES IN WSN's

localization in WSNs can be categorized in two networks management approaches the centralized and distributed localization. Generally, centralized algorithms can be used when we need more accuracy while distributed algorithms have better scalability.

1.4.1 Centralized localization

In this approach we have a powerful central-base node that the other sensor nodes communicate with and the central node does the computation and sends localization information to the sensor nodes. In this method, after sending data (measurements) from sensors to the server (it needs a database for saving received signals and computational data), they must receive acknowledge. This method reduces the problem of computation in sensor nodes and gives possibility to execute more complicated algorithms. However, the communication cost and scalability are some limitations and possibility of sensor node or central node failure are two issues. In some applications such as monitoring patients, controlling home, monitoring humidity and temperature in precise agriculture with central architecture, it is easy to use centralized localization.

1.4.1.1 MDS-MAP

This is a centralized algorithm for localization which has three steps:

- “Compute shortest paths between all pairs of nodes in the region of consideration. The shortest path distances are used to construct the distance matrix for MDS.

- Apply classical MDS to the distance matrix, retaining the first 2 (or 3) largest eigenvalues and eigenvectors to construct a 2-D (or 3-D) relative map.
- Given sufficient anchor nodes (3 or more for 2-D, 4 or more for 3-D), transform the relative map to an absolute map based on the absolute positions of anchors”

1.4.1.2 Localization node based on simulated annealing

This algorithm has access to the estimated location and other information of the neighbour nodes that are localizable in the system. This algorithm has two steps and it is useful for medium and high density sensor network:

- The algorithm is used to obtain an estimate of location of the localizable sensor nodes using distance constraints.
- In the next step the error caused by flip ambiguity is eliminated”

1.4.1.3 A RSSI-based centralized localization

This algorithm is based on signal attenuation to find distance. It is practical and self-organized program but uses more power to send much information to the central server. It has three steps:

- “RF (Radio Frequency) mapping of the network: It is obtained by conveying short packets at different power levels through the network and by storing the average RSSI value of the received packets in memory tables.
- Creation of the ranging model: All the tuples recorded between the two anchors are processed at the central unit to compensate the non-linearity and calibrate the model.

1.4.2 Distributed Localization

Distributed localization computation for positioning does not rely on one single node. Each sensor node has small memory and small processing time (limited processing potential). It means that the solution (algorithm) is simpler than centralized approach and sensors communicate with each other to find their location in the network. There are six classifications in this method.

1.4.2.1 Beacon-based distributed algorithms

In these algorithms some group of beacon nodes with unknown positions find their locations by using measured distance to the other beacon nodes. These algorithms are classified in Diffusion, Bounding Box and Gradient.

1.4.2.2 Relaxation-based distributed algorithms

These algorithms use a coarse algorithm with some refinement stages to reach an optimal solution. Spring model and Cooperative Ranging Approach are in this category.

1.4.2.3 Coordinate system stitching based distributed algorithms

In these algorithms, an area of sensors is firstly divided into small overlapping optimal local maps and then these local maps merge and make a single map. Cluster based approach is in this category.

1.4.2.4 Hybrid localization algorithms

These algorithms use two different localization techniques to decrease communication and computation cost. Like composing MDS (multidimensional scaling) and APS (ad-hoc positioning system).

1.4.2.5 Interferometric ranging-based localization

The idea in this method is to use two transmitters to create interference signals and then measure the composite signal frequency. Although in this method measurement is very precise, since Interferometric ranging needs a large set of measurements, this matter limits localization to the small networks.

1.4.2.6 Error propagation aware localization

This algorithm works based on integration of path loss and distance measurement error model. When a sensor node (with unknown position) finds its position with WLS (weighted least square) the algorithm becomes an anchor node (with known position) and broadcasts its information. This process continues until all sensors become anchors.

1.5 WIRELESS NODE POSITIONING TECHNIQUES' CLASSIFICATION

All localization algorithms in WSNs are totally classified in two groups of “range-free” (algorithms not based on distance measurement) and “range-based” (based on distance measurement) localization. Usually the range-based technique requires extra hardware for localization and the accuracy is better than range-free method. However, range-free method is cost-effective especially for large-scale networks.

1.5.1 Range-free

Range-free is a technique that uses content of messages (estimated distance instead of range measurements) and relies on network connectivity without using additional hardware and complicated computation and there are several approaches to reducing localization cost in the networks (in comparison to range-based). Since in this technique (range-free) the accuracy is not high, it depends on deploying a large number of anchor nodes to increase accuracy. It is considerable that researches in this technique mostly concentrate on algorithms that are not very practical. DV-Hop algorithm, Amorphous algorithm and APIT algorithm are typical range-free algorithms.

1.5.2 Range-based

The range-based algorithms are built on measurements to calculate the distance or angle between sensors (point-to-point measurement) and usually need extra hardware for localization and provide information on a specific signal. In fact, since this measured signal is used for range estimation, its name is range-based method. The localization accuracy in these algorithms is better than range-free algorithms and algorithms are more complicated. Usually range-based methods apply a server for localization and they have energy-saving strategy. In range-based method, localization is done by two steps: ranging and position computation. In ranging step the distance between two nodes (unknown position sensor and known position sensor) obtains by some method such as TOA (Time of Arrival), TDOA (Time difference of Arrival), RSSI (Received Signal Strength Indicator) or AOA (Angle of Arrival). In the positioning step the location of unknown node calculated by some methods such as Trilateration or Triangulation (based on geometric principle in triangles by using distance or angle information). TOA and TDOA method requires

additional acoustic hardware and the AOA method needs an additional antenna array however RSSI method does not need additional hardware and its accuracy is not enough.

1.6 PERFORMANCE EVALUATION OF RSSI LOCALIZATION

Performance evaluation of Received Signal Strength Indicator (RSSI) localization involves the assessment of the accuracy and reliability of the RSSI-based localization system. It involves testing the system under various conditions and scenarios to determine its effectiveness in accurately determining the location of an object or device in a given environment.

The evaluation process typically involves the following steps

- **Data collection:** The first step in evaluating the performance of an RSSI-based localization system is to collect data under different conditions. The data should include RSSI values from various points in the environment, as well as the actual location of the object or device being tracked.
- **Data pre-processing:** The collected data may contain noise, bias, or outliers, which can negatively impact the accuracy of the localization system. Pre-processing techniques such as filtering, clustering, and outlier detection can be used to remove noise and improve the quality of the data.
- **Algorithm selection:** There are several algorithms that can be used for RSSI-based localization, each with its strengths and weaknesses. The choice of algorithm will depend on the specific requirements of the system and the characteristics of the environment.
- **Training and testing:** The selected algorithm is trained on a subset of the data, and the accuracy of the model is tested on the remaining data. The training and testing process may be repeated multiple times using different subsets of the data to ensure that the results are robust.
- **Performance metrics:** To evaluate the performance of the localization system, various metrics such as accuracy, precision, and error rates can be used. These metrics provide a quantitative measure of the performance of

the system and can be used to compare different algorithms or system configurations.

- **Validation:** Once the performance evaluation is complete, the system should be validated by testing it in a real-world environment. This helps to ensure that the system can perform accurately and reliably in the intended application.

1.6.1 Accurate localization and tracking

The current trend is to obtain tracking precision down to a few centimetres. Localization accuracy is essentially tested by comparing the computed position with the actual target location. For evaluating these parameters, metrics.

1.6.2 Energy Efficiency

Tracking accuracy will improve as the No of active sensor nodes for localization and tracking jobs increases, albeit at the price of higher power consumption. Because WSNs are often energy restricted, the algorithm must be energy efficient enough to prevent duplicate communication between nodes. This improves energy efficiency and increases network longevity. One strategy to tackling this challenge is to use clustering and cooperation efforts between individual sensor nodes to selectively activate them. To improve energy efficiency, the computational complexity of the process must also be considered.

1.6.3 Number of beacon nodes present

The amount of beacon nodes present has a considerable influence on the accuracy of localization. Density improves localization and tracking precision. A higher beacon node density, on the other hand, comes at a larger cost to the system.

Many research efforts either strive for better Energy Efficiency at the price of tracking accuracy or strive for tracking accuracy while ignoring Energy Efficiency. While some programmers strive to strike a reasonable compromise between these two features in order to meet a particular purpose. However, precision is more crucial than speed, especially in mission-critical applications.

Overall, performance evaluation of RSSI localization is a critical step in the development and deployment of an RSSI-based tracking system. It enables developers to identify and address any issues with the system and ensure that it meets the performance requirements of the intended application.

1.7 RECEIVED SIGNAL STRENGTH (RSS) APPROACH

Received Signal Strength (RSS) approach is a technique used for estimating the location of a device in wireless communication networks. It involves measuring the strength of the signal received by a wireless device from different access points or base stations. The RSS approach uses the principle that the signal strength reduces as the distance between the device and the access point increases. Based on this principle, the RSS approach can be used to estimate the distance between the device and the access point, and hence its location.

The RSS approach involves measuring the signal strength of the wireless signal received from different access points or base stations. The signal strength is measured in the form of a signal strength indicator (SSI) or received signal strength indicator (RSSI). This measurement is made using a wireless receiver that is integrated into the device or a separate receiver that is attached to the device. The RSS values are used to estimate the distance between the device and each of the access points or base stations. The distance between the device and the access point is estimated using a mathematical relation that relates the RSS value to the distance between them. The mathematical relationship is typically based on a logarithmic function that relates the signal strength to the distance between the devices. The estimated distances between the device and each access point or base station are then used to triangulate the location of the device. Triangulation involves calculating the intersection of the circles that represent the estimated distance between the device and each of the access points. The point of intersection of the circles represents the estimated location of the device. The RSS approach has some limitations and challenges that affect its accuracy. These limitations include multi-path propagation, where signals are reflected from walls and other obstacles causing interference, and noise from other devices that can interfere with

the signal. These challenges require the use of sophisticated algorithms and techniques to improve the accuracy and reliability of the approach.

This method is based on a propagation signal model to estimate the distance between a sensor node and receiver with an antenna which can accurately measure the signal strength. So, knowing the transmitted signal power, antenna gained power and effects of different source of propagation error make possibility for localization. The relation between signal strength and distance is Signal Strength.

In summary, the RSS approach is a technique used for estimating the location of a device in wireless communication networks. It involves measuring the signal strength of the wireless signals received from different access points or base stations, and using the measured RSS values to estimate the distance between the device and the access points. The estimated distances are then used to triangulate the location of the device.

1.8 IOT DATABASE

An IoT database is a type of database designed specifically for storing and managing data generated by Internet of Things (IoT) devices. IoT databases are designed to handle the large volumes of data generated by IoT devices, which can include sensor data, device telemetry, and other types of machine-generated data.

IoT databases typically have the following characteristics:

- **Scalability:** IoT databases need to be able to handle large volumes of data generated by IoT devices, which can number in the millions or even billions. As a result, they need to be scalable to accommodate growth and changes in data volume over time.
- **Data ingestion:** IoT databases need to be able to ingest data from a variety of sources, including sensors, gateways, and other IoT devices. They also need to be able to handle data in real-time or near-real-time, as many IoT applications require immediate access to data.

- **Data storage:** IoT databases need to be able to store and manage large volumes of data over long periods of time. They also need to be able to handle a variety of data types, including structured, semi-structured, and unstructured data.
- **Data processing:** IoT databases often include data processing and analytics capabilities, allowing users to perform complex queries, aggregations, and analyses on the data stored in the database. This can include machine learning and AI-based analytics, which can help identify patterns and insights in the data.
- **Security:** IoT databases need to be secure, as they often contain sensitive data related to device operation and performance. They may also need to comply with regulatory requirements related to data privacy and security.

Some common IoT databases include Microsoft Azure IoT Hub, AWS IoT Core, and Google Cloud IoT Core. These databases offer a range of features and capabilities designed specifically for IoT use cases, such as data ingestion, storage, processing, and analytics. Other databases, such as NoSQL databases like MongoDB and Cassandra, can also be used for IoT applications, as they offer scalable and flexible data storage and processing capabilities.

1.9 VISUAL BASIC SOFTWARE

Visual Basic (VB) is a programming language and software development environment that is used to create Windows-based applications. VB was originally developed by Microsoft in the early 1990s as a way to simplify the process of developing Windows applications. Since then, it has become one of the most popular programming languages for Windows application development.

Visual Basic is a high-level, object-oriented programming language that is easy to learn and use. It features a simple syntax that is similar to natural language, making it easy for programmers to write code. The Visual Basic development environment includes a visual drag-and-drop interface for creating user interfaces, making it easy to design and create graphical user interfaces (GUIs) for Windows applications.

Visual Basic also includes a rich set of libraries and tools that make it easy to develop a wide range of Windows applications, including desktop applications, database applications, and web applications. Some of the features and capabilities of Visual Basic include:

- Object-oriented programming: Visual Basic is an object-oriented programming language, which means that it allows programmers to define and use objects in their code. This makes it easy to create modular, reusable code that can be used in different parts of an application.
- Event-driven programming: Visual Basic uses an event-driven programming model, which means that applications respond to user input and other events that occur at runtime. This makes it easy to create interactive applications that respond to user input and update their user interface in real-time.
- GUI development: Visual Basic includes a visual drag-and-drop interface for creating user interfaces, making it easy to design and create GUIs for Windows applications. The interface includes a range of controls, such as buttons, text boxes, and menus, that can be easily added to an application's user interface
- Database integration: Visual Basic includes tools and libraries for integrating with databases, making it easy to create database applications that can store and retrieve data. Visual Basic supports a range of database technologies, including Microsoft SQL Server, MySQL, and Oracle.
- Web development: Visual Basic can be used to create web applications using ASP.NET, a web development framework developed by Microsoft. ASP.NET allows programmers to create web applications that run on Windows servers and can be accessed using a web browser.

Overall, Visual Basic is a versatile and easy-to-learn programming language that is ideal for creating Windows applications of all types. It is widely used in the industry, and there are many resources available for learning and using the language, including tutorials, online courses, and community forums.

1.10 DIFFERENT APPROACHES FOR STUDENT ATTENDANCE MONITORING SYSTEM

There are several different approaches that can be taken when designing a student attendance monitoring system. Some of the most effective approaches are:

1.10.1 Biometric Attendance Tracking

One of the most advanced and efficient methods of monitoring student attendance is through biometric attendance tracking. This type of system uses biometric data such as fingerprints or facial recognition to identify each student and track attendance.

This system is very accurate and eliminates any chance of proxy attendance as it can only be marked by the genuine student. One drawback of this system is that it requires specialist equipment for reading the biometric data, which can be expensive.

1.10.2 Automated Student Attendance System

Automated systems utilize technology to check attendance. This system marks attendance by taking roll call through facial or finger recognition, RFID tags and QR codes. These systems can be integrated with the school, college, or university's website or application, allowing parents and students to check attendance on their mobile phone.

The advantage of this system is that it eliminates the need for a manual attendance record which can be less accurate and prone to errors.

1.10.3 Mobile Check-In System

One of the newer tracking systems is a mobile check-in system that uses GPS to track students as they arrive at school. Parents and students will need a downloadable app on their smartphones, and they can check-in when in proximity to the school or campus.

The advantage of this system is that it is easy to access and avoids any additional hardware costs.

1.10.4 Manual Attendance Monitoring System

The most economical option is a manual attendance monitoring system, which is also easy to implement. This system requires teachers to take attendance by hand and mark the attendance for each student in their class.

Despite the low cost, the manual system is prone to errors and manipulation. However, with the human touch, teachers can identify absent students quickly and counsel them.

1.10.5 A Novel Student Attendance Monitoring System Based on RFID Technology

RFID is used to power attendance control systems. As part of the system, each lecture hall has a personal computer connected to a single network. Each lecture hall has an RFID reader and a camera that is attached to a PC. The camera is used to photograph the students. As soon as a student enters the room, the camera captures a picture of him while the RFID reader reads his ID and sends information to a PC. The next chapter delves into the Automatic Identification and Data Capture (AIDC) technology. a concise description of AIDC technology as it is utilised in library administration and attendance systems.

1.10.6 Student Attendance Monitoring System using Biometric and GPS Tracking System

The most cost-effective biometric PC user authentication method, fingerprint authentication has various benefits including extremely high accuracy. One of the most popular and safest biometric identification techniques is this one. It's incredibly simple to use. The biometric template requires less storage space and is standardised, which reduces the amount of memory needed for the database. These issues can be resolved by biometric technology, and the proposed fingerprint-based attendance system would be perfect for use in colleges as an identifying method.

1.10.7 Student attendance monitoring system using QR-codes and mobile devices

The method based on QR codes that uses mobile devices to display and scan the codes. Thus, there is no longer a need for any additional gear. It should be noted that Malaysia has a high rate of ownership of mobile internet-capable devices, particularly smartphones, as well as a high rate of mobile internet usage, with rising aerial coverage and penetration over time.

1.10.8 Student Attendance monitoring system using face detection and face recognition

Based on a facial recognition algorithm, the suggested automatic attendance management system. A person's image is recorded by the camera at the entryway when they enter the classroom. Following extraction, the face region is prepared for processing. Face detection takes less time because just two persons can be in the full classroom at once. Compared to previous systems that have been discussed for analysing facial recognition and recording attendance, face recognition has proven to have advantages.

In conclusion, all approaches for student attendance monitoring systems have their advantages and disadvantages. The best approach is to assess each system's capabilities, the size of the school, and the available budget before deciding which system to implement. Ultimately, a reliable and efficient attendance monitoring system helps in maintaining an optimal learning environment for students.

CHAPTER 2

LITERATURE REVIEW

RSSI (Received Signal Strength Indicator) is a measurement of the strength of the radio signal received by a wireless device, which is commonly used in wireless communication systems such as Wi-Fi, Bluetooth, and ZigBee. It plays a vital role in wireless localization and tracking, as it enables the estimation of the distance between the receiver and transmitter. A substantial amount of research has been carried out on RSSI-based localization techniques for indoor and outdoor environments. RSSI-based localization can be classified into two categories: range-based and range-free. Range-based techniques use RSSI values to estimate the distance between the receiver and transmitter, while range-free techniques use the RSSI distribution to estimate the position of the receiver. In this literature review, we will focus on the range-based techniques. One of the most common range-based techniques is the trilateration method, which uses the RSSI values from at least three access points (APs) to estimate the location of the receiver. This technique has been widely studied in indoor localization applications, such as asset tracking, indoor navigation, and location-based services. A study by Bahl and Padmanabhan (2000) showed that using three APs, the trilateration method can achieve an accuracy of 1-2 meters in an indoor environment.

Another technique that has been studied extensively in range-based localization is the fingerprinting method, which uses a pre-collected database of RSSI values from various locations in the environment to estimate the position of the receiver. The fingerprinting method has been shown to achieve high accuracy in indoor localization, with an error of less than 2 meters in some cases. Hong et al. (2009) proposed a fingerprinting-based localization system using RSSI values and achieved an accuracy of 1.86 meters in an indoor environment.

However, there are several challenges associated with RSSI-based localization techniques. One of the main challenges is the non-line-of-sight (NLOS) propagation of the radio signal, which can significantly affect the accuracy of the RSSI measurements. To overcome this challenge, several researchers have proposed using machine learning algorithms to improve the accuracy of RSSI-based localization. For example, Sharma and Dukkupati (2015) proposed a machine learning-based system using an artificial neural network to estimate the location of the receiver based on RSSI values, achieving an accuracy of 2.17 meters in an indoor environment.

Another challenge is the variability of the RSSI values, which can be affected by factors such as interference, multipath propagation, and environmental conditions. To improve the accuracy of RSSI-based localization, several researchers have proposed using signal processing techniques, such as filtering and smoothing, to reduce the variability of RSSI values. Zhang et al. (2019) proposed a multi-level filtering method to reduce the variability of RSSI values, achieving an accuracy of 1.5 meters in an indoor environment.

2.1 LITERATURE SURVEY BASED ON RESEARCH

Muzammil Ula et al- Systems for controlling attendance are built around RFID. Each lecture hall has a personal computer connected to a single network as part of the system. Every lecture hall is equipped with an RFID reader and a webcam that is linked to a PC. Pictures of the students are taken using the camera. The webcam takes a photo of the student who registers as the RFID reader instantly reads his ID and sends information to a PC as soon as a student enters the room. The Automatic Identification and Data Capture (AIDC) technology is discussed in the next chapter. a succinct explanation of the AIDC technology used in library administration and attendance systems.

Firdous kausar et al- A web-based application employing WSN has been created to provide remote home security monitoring, and it is being implemented in a real WSN environment using moteivtmotes. It has the ability to detect theft, and if any harmful conditions are found, it can send the user's cell phone a warning SMS.

J.Chandramohan1 et al - The most cost-effective biometric PC user authentication method, fingerprint authentication has various benefits including extremely high accuracy. One of the most popular and safest biometric identification techniques is this one. It's incredibly simple to use. The biometric template requires less storage space and is standardised, which reduces the amount of memory needed for the database. These issues can be resolved by biometric technology, and the proposed fingerprintbased attendance system would be perfect for use in colleges as an identifying method

Kimio Oguchi et al-In this study, a new signal processing technique is proposed along with a method for estimating the location of a human using the RSSI of a wireless sensor network. Two experiments are used to confirm its viability and performance. This paper is organised as follows: introduces the system image's outline. summarises the two experiments and the estimating method suggested.

Yu-Tso Chen et al-user of mobile inside the home by inquiring regarding RSSI solutions for indoor localization. The investigation results depict that projected Closer Tracking Algorithm has the ability to reveal the accurate position with error 6 distances less than 1 meter. If the distance is less than one member, the suggested Closer Tracking Algorithm has minimum 85% precision at the same time. The proposed Closer Tracking Algorithm was implemented by using ZigBee CC2431 modules.

Praveen Kumar et al-The authors of this work attempted to measure the distances between installed sensor nodes under ideal circumstances. The structure of this essay is as follows: explains the relevant work. the localisation model is presented. depicts the outcomes of the simulation.

Subhas C. Mukhopadhyay et al- which are used for home monitoring particularly to look after aged people. The monitoring system is established on the combination of several sensors, and it has the ability of broadcasting data via wireless communication. The central processor collects data and stores all data for current requirement and for future purpose. The system stores the habit of life style of a person. The system compares collected data with stored pattern, which depends on situations and actions are already defined like abnormal or unusual. In case of any abnormal activity, the system detects it and generates an alarming or warning or SMS and it is transmitted to the caregiver. This wireless sensing system is available for this type of application with low cost and has great potential to save human lives of old age people.

Erin-Ee-Lin Lau et al- The system addressed in this study has similarities with previous RSSI-based position tracking systems in terms of calibration of propagation constants, although the smoothing technique is not included in other systems. It performs better than the other systems in terms of accuracy while using this smoothing approach.

A.A.A. Rahni et al - The method based on QR codes that uses mobile devices to display and scan the codes Thus, there is no longer a need for any additional gear. It should be noted that Malaysia has a high rate of ownership of mobile internet-capable devices, particularly smartphones, as well as a high rate of mobile internet usage, with rising aerial coverage and penetration over time.

P. Kowsalya et al - Based on a facial recognition algorithm, the suggested automatic attendance management system. A person's image is recorded by the camera at the entryway when they enter the classroom. Following extraction, the face region is prepared for processing. Face detection takes less time because just two persons can be in the full classroom at once. Compared to previous systems that have been discussed for analysing facial recognition and recording attendance, face recognition has proven to have advantages.

Gadekar et al- The students fingerprint area unit scanned by a code. the students impress the fingerprint against the scanner the system compares the new fingerprint patterns and it will be connecting to the various points for the fingerprint to the database. A match is recorded as knock The camera will now capture your image. If the image detected matches to the sample image for the database. The attendance marked as present on the LCD. if the camera fails the fingerprint scanner will be activated and the attendance will be marked present

Pasumarti et al - When the Student images are stored the database. the raspberry pi camera module is placing the student entering in the class room. the USB camera module is capture the student image. the system will automatically update the student presence in the class to the students database and sends message to guardians of absentees and also to head of department.

Bhattacharya, et al - A Face Recognition Based Attendance System for Classroom Environment : When the Student images are stored the database. the raspberry pi camera module is placing the student entering in the class room. the USB camera module is capture the student image. the system will automatically update the student presence in the class to the students database and sends message to guardians of absentees and also to head of department.

Soniya, V., et al- Attendance automation using face recognition biometric authentication: The system that can be automatically capture students' attendance by flashing their student card at the RFID reader to entering the class room. The student ID is instantly capture by the reader after that the data is sent to the online server for recording the system help to automatically compute the percentage of attendance of each individual student. The GUI of user list function for adding and removing the students' personal details

Uma, et al - When the Student images are stored the database. the raspberry pi camera module is placing the student entering in the class room. the USB camera module is capturing the student image. the system will automatically update the student presence in the class to the students database and sends message to guardians of absentees and also to head of department

Chandramohan, J., et al- Attendance Monitoring System of Students Based on Biometric and GPS Tracking System : The finger print module then we are taking the sample of there are four finger print and they are detected along the images when the user that should keep finger on the module and it will be scanning and compared is already stored in the memory the person whose finger print is matched their will be marking present and not matching the sms send to his parents

Lukas, et al- Student attendance system in classroom using face recognition technique: The face recognition is captured the student's image. The students entering in the classroom or everybody already occupies in the classroom. The student's attendance automatically recognized

Kassim, et al - Web-based student attendance system using RFID technology: The system that can automatically capture students' attendance by flashing their student card at the RFID reader to enter the class room. The student ID is instantly captured by the reader after that the data is sent to the online server for recording.

2.2 LITERATURE SURVEY BASED ON EXPERIMENTS

Smart Attendance using image processing techniques

The query image in this intelligent attendance system will be compared to the student images from the prior database that were saved at the time of enrollment. 4 to 5 pictures will be taken by the camera at the foreordained time openings concurring with the plan, and the database will compare these pictures. The images are evaluated against the data on the web using image processing techniques. Unrecognized faces will be marked absent, while those that are recognized will be marked as present. This entire data set is kept in an Excel sheet.

Smart Attendance System

Typically, attendance at universities is recorded on paper, which could result in errors. It takes longer to manually take attendance. In the past, we used techniques like roll number calling and handing out attendance sheets to the students, which had problems like proxy attendance and required a lot of time and work. So, in order to simplify this, we developed an Attendance System using the Raspberry Pi in this project.

Facial Recognition Attendance System Using Python And Opencv

For this extend, confront databases will be built in arrange to supply data to the recognizer calculation. Amid the session for recording participation, faces will be compared to the database to recognize anybody. When a individual is perceived, the framework will consequently record their participation and spare the vital data to an exceed expectations sheet. At the conclusion of the day, the fitting staff is sent the exceed expectations sheet with all students' participation data.

Mobile Application For Student Attendance And Mark Management System

Workforce and other organization staff who reliably keep up participation and grades are the target group of onlookers for this application. This framework can be utilized by the subject facilitators, staff, or specialists to confirm how numerous understudies were display or truant amid lesson gatherings. With the assistance of this app, clients can keep track of participation and communicate with understudies on their versatile gadgets. Utilizing this application, the instructors can alter their participation and include marks to the framework database for afterward recovery. An caution message is sent to a understudy some time recently their participation drops underneath a certain level.

Internet Of Things-Based Intelligent Attendance System: Framework, Practice Implementation, And Application

It compares the advantages and disadvantages of smart attendance management systems currently in use. In order to develop an IoT-based intelligent attendance management system, authors used the cloud, an authorsb server, Google API, a non-contact body temperature sensor, and a Raspberry Pi 4 (4G) module. Authors evaluated the satisfaction levels with our system after conducting a survey at a university.

In conclusion, RSSI-based localization techniques have been extensively studied in indoor and outdoor environments, and have shown great potential for various applications, such as asset tracking, indoor navigation, and location-based services. However, to achieve high accuracy, several challenges associated with RSSI such as NLOS propagation, variability, and interference need to be addressed. Machine learning algorithms and signal processing techniques have been shown to be effective in improving the accuracy of RSSI-based localization.

CHAPTER 3

AIM AND SCOPE OF WORK

3.1 AIM

The main aim of the project is to develop an RSSI-based localization algorithm to find a precise location of a moving student ID in a college and improve this localization by considering environmental conditions. In particular, the objectives are to:

- Study and describe the RSSI-based localization algorithms, focusing on environmental conditions improvement.
- Describe and evaluate different methods which can improve the localization precision.
- Develop a server application to carry out the analysis phase.
- Compare the achieved results from different experiments to see the worst and best Situations and distance errors.
- Find some research areas (based on the mapping study) in the context of the RSSI-based localization in which there is a lack of studies.

3.2 OBJECTIVE

- Reducing the time taken for the attendance in the classroom manually
- Unlike the manual process , an online system easily helps the management to analyze student's attendance details as per requirement
- By doing this process there is less chance of error
- Without student interface attendance and present classroom or auditorium, The student present data can be taken with time

3.3 PROBLEM DEFINITION

The problem at hand is to design an integrated classroom attendance system that incorporates indoor positioning using Received Signal Strength Indicator (RSSI) technology. The system will be used to automatically track the attendance of students and teachers in a classroom environment using wireless communication signals. The system will use RSSI technology to measure the signal strength of wireless devices carried by students and teachers to determine their location within the classroom.

The system will consist of a network of wireless access points (APs) that will be deployed throughout the classroom. The APs will transmit signals that will be received by the wireless devices carried by the students and teachers. The RSSI values of these signals will be used to calculate the position of the devices within the classroom. The system will use this information to automatically generate attendance reports for the class.

The system will also include a user interface that will allow teachers to view attendance reports and monitor the attendance of their students in real-time. The system will be designed to be easy to use and reliable, with minimal maintenance requirements. The system will need to be scalable, able to handle multiple classrooms, and support different wireless communication protocols.

3.4 SCOPE OF THE WORK

The scope of the project is that it focuses on a specific algorithm in the RSSI-based localization in classroom WSN. To perform this study and relevant analysis, initially, the simple part of the algorithm is implemented as a server application to analyse the results of the experiments. The previous tracking system was done using GPS, which did not have the efficient accuracy that is necessary to track the student. Next came the ultrasonic tracking system, where many ultrasonic sensors are to be used which led to an increase in cost for installation and was also labour intensive. This type of tracking is again a defective method as the precision is directly proportional to the number of sensors that is to be installed. Later, Laser range finders were developed as a powerful tool for finding a human with high precision, but the disadvantage of this arrangement is that it only covers small areas. The latest study of this project focuses on RSSI-based localization, which is formulated by improving the precision of the localization algorithm, the results of experiments are evaluated time-to-time, and also the main effective parameter (Path-loss exponent and its relation with environmental condition) is considered. With its high accuracy and working ability, this system proves to be the best in the theoretical and simulation aspect. This system has limited battery consumption and a variation set of radii that determines the location of the candidate.

CHAPTER 4

MATERIAL AND EXPERIMENTAL METHOD

4.1 RSSI

It can be said that the RSSI esteem is higher with a more grounded flag, as RSSI gives an sign of the control level gotten by a collector from an Get to Point (AP). Commonly known as WiFi, this remote innovation falls beneath Remote Nearby Range Organize (WLAN), being trademarked by the WiFi Union. Leveraging the 2.4GHz or 5 GHz SHF ISM radio groups, 802.11 organizing empowers electronic gadgets to connect up to a arrange [2]. 802.11 organizing uses radio frequencies that are higher than those utilized by tv, walkie-talkies, and cellular phones to supply information transmission of up to 70 meters (6 Mbits/s) in a restricted environment [3]. The RSSI of an Get to Point (AP) connected with a WiFi arrange can be utilized for nearness location and other applications. RSSI is the control level gotten by the collector as well as the quality of the flag broadcasted by the AP; in this way, a more grounded flag ought to result in a bigger esteem of RSSI [1]. Moreover, WiFi is another title given to Remote Nearby Region Network(WLAN) items. It is named beneath this trademark which is claimed by the WiFi Union [2]. 802.11 organizing uses radio wave signals to empower information transmissions up to 70 meters (6 Mbits/s) inside. It is conceivable to utilize the RSSI of an get to point associated to a WiFi organize and utilize this design for exercises such as human nearness recognizable proof. The MAC, NWK, and APL layers can degree the gotten flag quality (vitality) of each parcel and typically quantized into the gotten flag quality marker (RSSI). This RSSI and the comparing gathering timestamp can be inspected for different sorts of examination; one illustration would be making the connect quality pointer by taking RSSI as a degree of connect quality (LQI). The RSSI can be used to develop a essential however successful area estimation framework. There's no require for any additional equipment for each hub within the arrange with this strategy, since RSSI can be gotten to effortlessly. The four components of this esteem are energetic run, exactness, linearity, and averaging period. Energetic

extend is measured in dB and uncovers the littlest and most prominent amount of flag quality that the collector is able of measuring. Taking an case, in the event that a receiver's RSSI features a energetic extend of 92 dB (from 88 dBm to +4 dBm), the slightest flag vitality it can see is 88 dBm whereas the most noteworthy one it can distinguish as an RSSI is 4 dBm. The precision signifies the normal deviation related with each estimation of gotten flag control. The RSSI precision of a normal, commercially accessible handset is anticipated to be at slightest 4 dB. As the RSSI plot shows the actual flag control versus a straight line, RSSI linearity speaks to the greatest deviation from a straight line. The gotten flag quality is more than once measured and after that found the middle value of to create RSSI. IEEE 802.15.4 requires an averaging time of eight image periods when utilizing RSSI to create LQI. Sending a flag to a followed hubis the quickest way to decide its area. The reference hub that records the most grounded RSSI is expected to be the area of the followed hub. Leveraging low-cost and battery-operated hubs with restricted memory and handling capabilities, this approach empowers simple execution. Be that as it may, its area estimation exactness may not fulfill the prerequisites of numerous applications. Subsequently, expanding the number of grapple hubs for progressed precision isn't appropriate for cost-sensitive applications.



Fig: 4.1: RSSI Module

4.2 NODE MCU WITH RSSI (ESP8266)

NodeMCU is an open-source firmware and development kit based on the ESP8266 WiFi module. The ESP8266 is a highly integrated WiFi chip that can function as a

microcontroller and WiFi module. One of the features of the ESP8266 is its ability to measure the received signal strength indicator (RSSI) of WiFi signals.

NodeMCU with RSSI can be used for a variety of applications, including indoor positioning, WiFi signal strength measurement, and WiFi signal mapping. Here's how it works: NodeMCU is programmed using the Lua scripting language, which makes it easy to develop applications without the need for additional software or hardware. The ESP8266 WiFi module can be configured to scan for nearby WiFi networks and measure their RSSI values. This can be done using the built-in WiFi library in the NodeMCU firmware. The RSSI values can be transmitted to a computer or other device for processing and analysis. This can be done using the serial communication interface on the NodeMCU board.

The RSSI values can be used for a variety of applications, such as indoor positioning, WiFi signal strength measurement, and WiFi signal mapping. For example, in an indoor positioning system, the RSSI values can be used to triangulate the position of a device based on the strength of the WiFi signals from nearby access points.

4.2.1 NodeMCU with RSSI has several advantages, including

- Low cost: The NodeMCU board is relatively inexpensive, making it an affordable option for developers and hobbyists.
- Easy to use: The Lua scripting language is easy to learn and can be used to develop applications quickly and easily
- WiFi capability: The ESP8266 module provides WiFi connectivity, allowing the NodeMCU board to connect to wireless networks and transmit data wirelessly.
- Customizable: NodeMCU firmware can be customized and extended using Lua scripts, allowing developers to create their own applications and functionality.

The NodeMCU was made utilizing the ESP8266, a low-cost System-on-a-Chip (SoC) by Espressif Frameworks. Composed of a CPU, Slam, organizing (WiFi), and

an working framework with SDK, it is perfect for any Web of Things (IoT) ventures. In any case, when utilized as a chip, it can be troublesome to get to; wires must be fastened with the suitable simple voltage to its pins in arrange to perform common capacities such as fueling it up or sending a keystroke. Moreover, coding at this level requires composing in low-level machine informational that the equipment can decipher. In spite of this complexity, the ESP8266 might still be reasonable as an implanted controller chip for mass generation hardware.



Fig: 4.2: Node MCU

However, there are also potential challenges and limitations associated with NodeMCU with RSSI, such as those related to signal interference, signal attenuation, and device heterogeneity, as discussed earlier. Careful design and testing of the system would be necessary to ensure its reliability and accuracy in different environments.

4.3 VB SOFTWARE

VB may be a Microsoft-created event-driven and object-oriented programming dialect and environment, with a graphical client interface (GUI) which rearranges the method of coding by permitting clients to drag and drop objects and indicate their conduct and appearance. Recognized as fast application advancement (RAD), it was determined from Essential and permits engineers to rapidly make an application model some time recently they move on to composing in a more complex but effective language. The objective of VB is to create it direct to memorize as well as proficient to type in code.

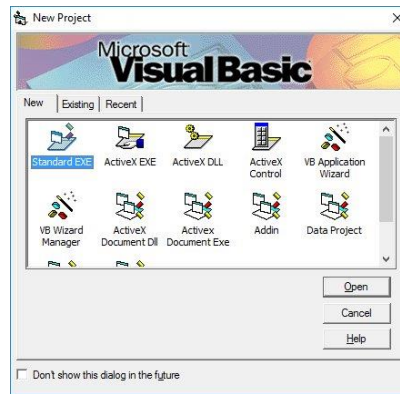


Fig: 4.3:Visual Basic Software

4.4 INTERNET OF THINGS (IOT)

The development of the Web of Things has made a unused way for 21st century innovation. Interfacing regular things like cars, kitchen machines, indoor regulators, and infant screens to the internet through implanted gadgets permits nonstop communication between individuals and things. Low-cost computing and mobile technologies empower physical objects to gather and share information with negligible human intercession, whereas cloud computing and enormous information analytics offer assistance to record, screen, and alter intelligent between associated gadgets. The number of IoT gadgets around the world is over 7 billion, assessed to hit 10 billion by 2020 and 22 billion by 2025. This hyperconnected world opens up endless openings for everybody.

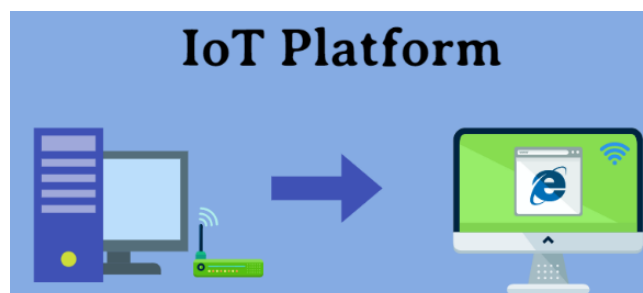


Fig: 4.4: Internet of Thing

4.5 BLOCK DIAGRAM

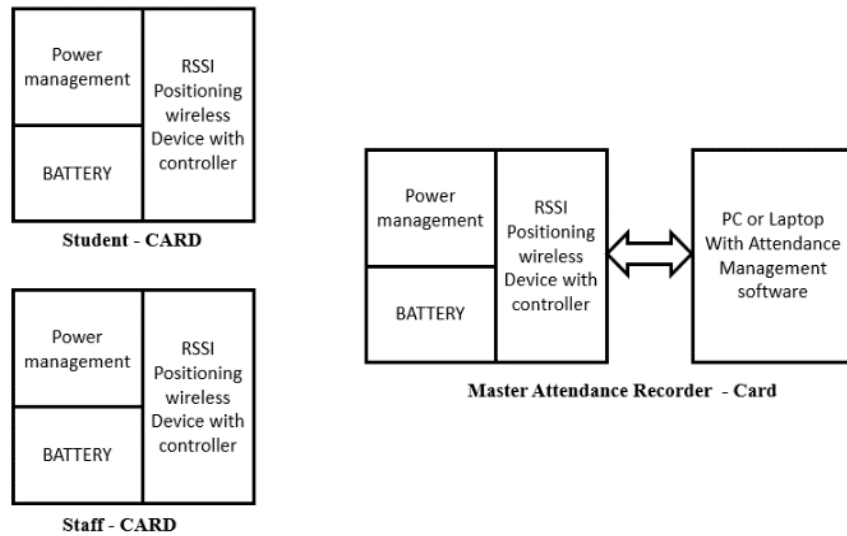


Fig: 4.5: Block Diagram of ID card

In the diagram, we see that there are two types of cards , one is student card and the second one is for staff card. The cards will be working as the indoor localization. Once the student comes into the range, he will be detected using the RSSI card by indoor localization algorithm. Then he will be marked present. Once he left the range, he will be marked as absent. For the communication from the card reader to system, Arduino controller is being used, which will get the data from the card and will pass it on to the system. In the system, we can see the details using the VB software and the same can be passed to IOT by using the IOT Server.

4.6 RSSI ALGORITHM

This proposed calculation yields a single-dimensional collection (R) of RSSI tests. MIN(R), MAX(R), and AVERAGE(R) are characterized to extricate the least, most extreme, and cruel RSSI values separately. A clustering calculate is utilized to subtract the sub-classification middle from each outright RSSI esteem. In the mean time, a trilateration-based IPS isolates the method into offline and online stages. Amid the offline organize, steps such as sending of grapples, RSSI gathering, crude

estimation of RSSI, and fitting of path-loss example are attempted with the point of adjusting it. As for the online arrange, real-time gathering and estimation of RSSI, separate mapping together with calculation of arranges happen whereas optimization and redress are utilized to make strides situating precision

RSSI (Received Signal Strength Indication) is an algorithm used to measure the strength of a radio signal received at a receiver. This algorithm takes into account the power level of the signal, the frequency of the signal, the bandwidth of the signal, and the modulation type of the signal. The algorithm is used to estimate the distance between the transmitter and the receiver based on the strength of the signal.

The RSSI value is usually measured in dBm and provides an indication of how strong the received signal is. The closer the RSSI value is to 0 dBm, the stronger the signal is. If the value is negative, it means that the signal is weaker than 0 dBm.

There are many factors that can affect the accuracy of the RSSI value, including interference from other signals, environmental factors, and the quality of the receiver antenna. To improve the accuracy of the RSSI value, it may be necessary to perform a calibration process which involves measuring the RSSI value at different distances and with different environmental factors. In addition to determining the distance between the transmitter and receiver, the RSSI algorithm can also be used to determine the position of the transmitter based on the signal strength from multiple receivers. This is known as trilateration and is commonly used in GPS systems.

Overall, the RSSI algorithm is a useful tool for measuring the strength of radio signals and can be used in a wide range of applications, from wireless communication systems to location tracking systems. However, as with any algorithm, it is important to take into account the limitations and potential sources of error when using it in a real-world scenario

4.7 CONNECTING VISUAL BASIC SOFTWARE TO AN IOT DATABASE

- There are several IoT databases available, including Microsoft Azure IoT Hub, AWS IoT Core, and Google Cloud IoT Core. Setting up rssi database according to the provider's instructions. This will typically involve creating an account, creating a database, and configuring access.
- Install the necessary software libraries: To connect to the IoT database, you'll need to install the necessary software libraries in Visual Basic. These libraries will depend on the IoT database you are using. For example, if you are using Microsoft Azure IoT Hub, you'll need to install the Azure IoT Hub SDK for .NET.
- Then we need to Write code to connect to the IoT database: Once have installed the necessary software libraries, and write code in Visual Basic to connect to the IoT database. This will typically involve creating a client object and specifying the connection parameters, such as the database URL and authentication credentials.
- Send and receive data: Once we have established a connection to the IoT database, we can send and receive data using Visual Basic. For example, sending rssi node 1 value sensor data from an IoT device to the database, or we can retrieve data from the database and display it in a Visual Basic application.
- Handle errors and exceptions: When working with IoT devices and databases, it's important to handle errors and exceptions gracefully. Make sure to include error-handling code in your Visual Basic application to handle situations where the connection to the database is lost or the data cannot be retrieved.

4.8 EXISTING SYSTEM AND PROPOSED SYSTEM

4.8.1 Existing system

In the existing system, RSSI (Received Signal Strength Indication) is used in wireless communication systems to measure the strength of the received radio signal. It is a measure of the power level of the received signal relative to a reference power level. The reference power level is usually the power level of a known signal transmitted by the same radio transmitter at a known distance away.

RSSI is used in many wireless communication systems, including Wi-Fi, Bluetooth, Zigbee, RFID, and cellular networks. In these systems, RSSI is used for various purposes, such as estimating the distance between two devices, adjusting the transmission power of the radio transmitter, and improving the reliability of the wireless communication. However, the accuracy of RSSI measurements is affected by various factors, such as noise, interference, multipath propagation, and signal attenuation. Therefore, the existing system may suffer from reduced performance and reliability when the wireless environment is complex or dynamic.

In the existing model, the system is designed by applying the facial recognition, in which there are lot of drawbacks like non clarity, blur images etc. Due to these issues, the data's are not being read properly.

Disadvantages

- Unable to get clear data.
- Cost effective.
- Not reliable.

4.8.2 Proposed system

The proposed system aims to enhance the performance and reliability of wireless communication systems by using RSSI in a novel way. Specifically, the proposed system leverages advanced machine learning techniques to improve the accuracy of RSSI measurements and to extract meaningful information from them.

The proposed system consists of three main components: a data acquisition module, a machine learning module, and an application module. The data acquisition module collects RSSI measurements from the wireless environment using a network of sensors deployed in the area of interest. The machine learning module uses advanced algorithms, such as neural networks, to learn the relationship between RSSI measurements and various parameters of interest, such as distance, location, and occupancy. The application module uses the results of the machine learning module to provide useful services and applications, such as indoor positioning, localization, tracking, and monitoring. The proposed system has several advantages over the existing system. First, it can improve the accuracy and reliability of RSSI measurements by mitigating the effects of noise, interference, and multipath propagation. Second, it can extract meaningful information from RSSI measurements that can be used for various applications, such as indoor navigation, location-based services, and asset tracking. Third, it can adapt to changing wireless environments and learn from new data, which can improve the system's performance over time.

In the proposed system, RSSI based system is used, which will work on the indoor localization algorithm. Once the student is detected in the range , it will detect automatically and the data's will be passed to the software and the online IOT system.

Advantages

- More output clarity.
- Tracking is easier.
- Data's can be monitored from anywhere using the IOT.

In summary, the proposed system aims to leverage the power of machine learning to enhance the performance and reliability of wireless communication systems that use RSSI. The system can provide valuable insights and services that were previously unavailable in the existing system.

4.9 WORKING PROCEDURE

An RSSI-based indoor positioning integrated classroom attendance system can be designed to track the presence of students in a classroom using RSSI readings from their ID cards. The system would consist of several components, including:

- ID cards: Each student would be required to have a ID cards device with WiFi capability,
- WiFi access points: Several WiFi access points would be installed throughout the classroom to provide coverage and allow for RSSI readings to be taken.
- Database: A database would be used to store information about each student's device and their RSSI readings.
- Attendance software: An attendance software program would be developed to process the RSSI readings and determine which students are present in the classroom.

4.9.1 The system would work as follows

Step 1: Students enter the classroom and turn on their ID cards device.

Step 2: The Wi Fi access points in the classroom take RSSI readings from each student's device.

Step 3: The RSSI readings are transmitted to the attendance software program, which compares them to a database of known RSSI values for each student's device.

Step 4: Based on the RSSI readings, the attendance software program determines which students are present in the classroom and records their attendance.

4.9.2 There are several advantages to using an RSSI-based indoor positioning system for classroom attendance, including

- Convenience: The system would allow attendance to be taken automatically, without requiring manual tracking by the instructor or students.
- Accuracy: The use of RSSI readings can provide a more accurate and reliable attendance record than traditional methods, such as paper-based sign-in sheets.
- Efficiency: The system would save time and reduce the workload for instructors, who would no longer need to spend time taking attendance manually.
- Real-time feedback: The system could provide real-time feedback to instructors on which students are present in the classroom, allowing them to adjust their teaching approach accordingly.

4.10 TRANSMITTER MODULE

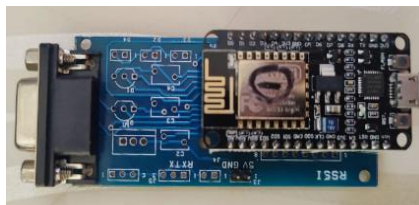


Figure 4.6: Transmitter Module

A transmitter is an electronic device that is used to transmit or send signals from one location to another through a medium such as wires, air, or space. A transmitter usually contains a transducer, which converts electrical signals into an electromagnetic signal such as radio waves, microwave, or infrared light. The electromagnetic signal is then sent through an antenna, which is designed to radiate the signal into the environment. The transmitter typically includes a mixer, amplifier, and modulator that process and modify the signal before it is transmitted. The modulator shapes the signal according to the type of modulation used, such as amplitude modulation (AM), frequency modulation (FM), or phase modulation (PM).

This is the RSSI Transmitter Module that the students will have. The signal will be transmitted to the receiver end and updated in the VB software as soon as the student enters the range. In this module we have a NodeMCU controller, in which we can make the coding for the data transmission. The coding is done in the embedded c.

4.11 RECEIVER MODULE



figure 4.7: Receiver module

On the other hand, a receiver is an electronic device that detects and decodes the electromagnetic signal that is transmitted by the transmitter. The receiver typically includes an antenna that receives the signal and converts it back into an electrical signal. The electrical signal is then processed and amplified by a chain of electronic circuits that include filters, mixers, and demodulators. The filters remove unwanted noise and interference, while the mixers combine the signal with a local oscillator signal to produce an intermediate frequency signal that is easier to process. The demodulator extracts the modulation information from the signal, which is then sent to the output device such as a speaker, display screen, or computer

This Node MCU and RSSI-based receiver module is used in our project. It receives signals sent by the RSSI transmitter and updates the visual basic program. Embedded C software is being used to code the Node MCU. In this module also we are making use of the Node MCU module. In which the coding is done for receiving the signal once it comes into the range.

CHAPTER 5

RESULTS AND DISCUSSION

A transmitter converts electrical signals into electromagnetic signals and sends them through an antenna, while a receiver detects the electromagnetic signals through an antenna, converts them back to electrical signals, and decodes them into meaningful information. These two devices work together to form a communication system that enables the transmission of information over long distances.



Fig: 5.1: Visual Basic Software

This is the IOT Page, where the datas will be updated from the system . This page will be accessible from anywhere where internet is present. This page is being created in the Visual Basic software . This is the desktop software,in which all the datas are being read and displayed in the system. In this module , the coding is done in such a way that the data will be sent to the Internet of things web page, where it is accessible anywhere in the world.

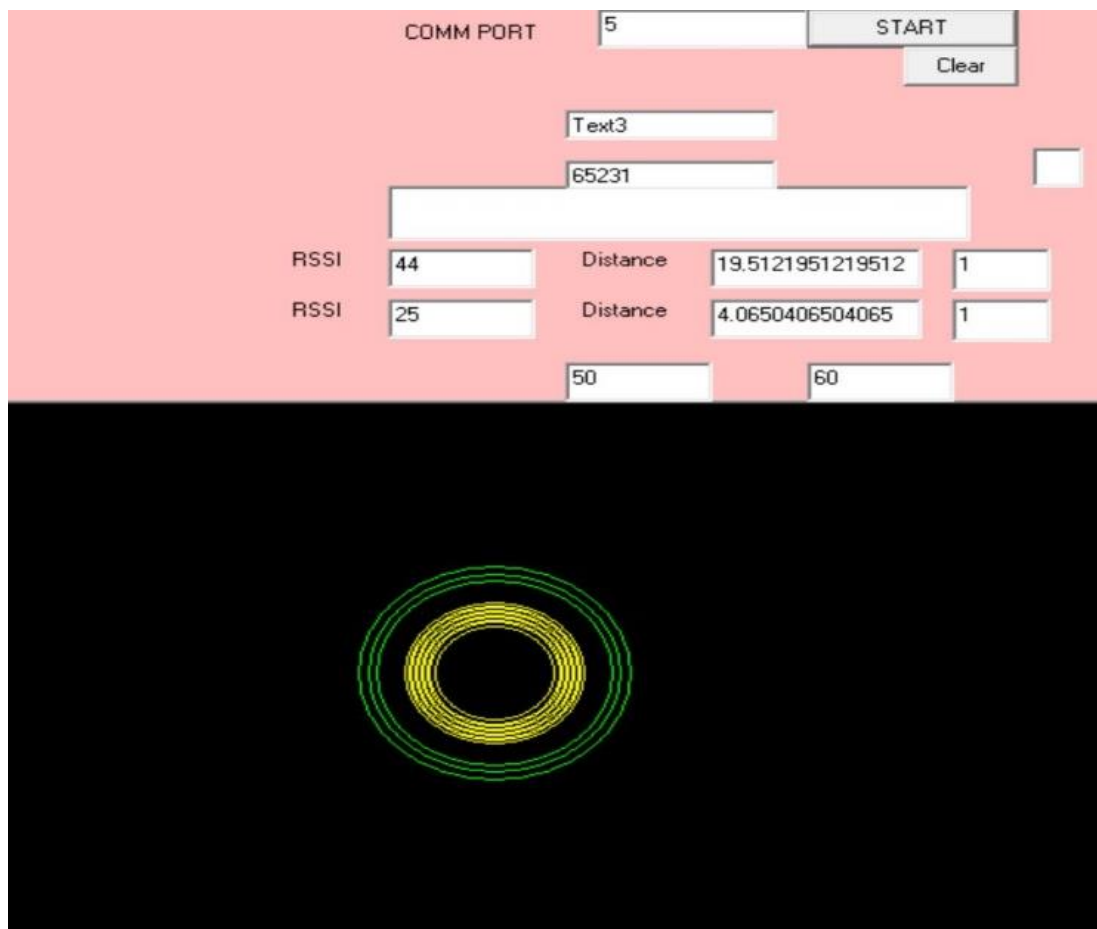


Fig: 5.2 :RSSI data simulation module

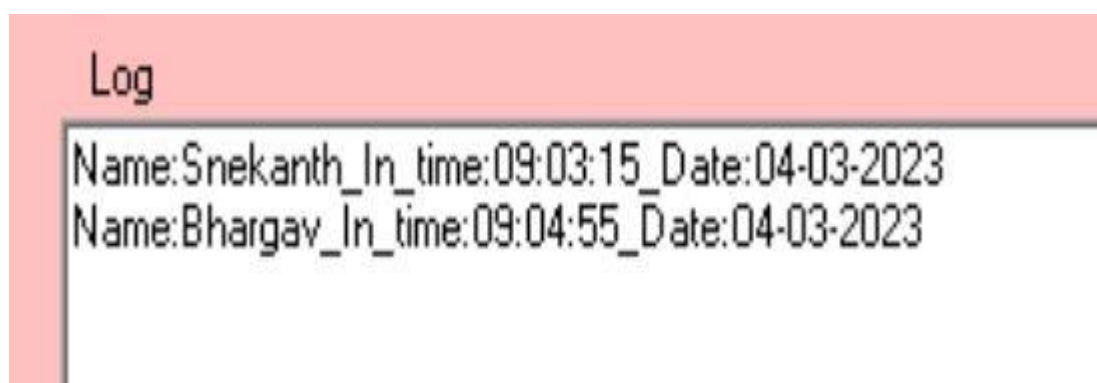


Fig: 5.3: Output data in Log

Wifi-IOTLogs

HOME

Data Log

Analog Log

Digital Output

Digital Input

ViewGraph

Click Here to Delete Logs | CLEAR LOGS

Show 10 entries

Search:

LogID	DATA	Logdate	LogTime
1	Name:Snekanth_In_time:20:41:29_Date:25-02-2023	02/25/2023	20:41:30
2	Name:Bhargav_In_time:20:43:15_Date:25-02-2023	02/25/2023	20:43:16
3	Name:Snekanth_In_time:20:43:41_Date:25-02-2023	02/25/2023	20:43:42
4	Name:Bhargav_In_time:20:45:13_Date:25-02-2023	02/25/2023	20:45:14
5	Name:Snekanth_In_time:20:45:23_Date:25-02-2023	02/25/2023	20:45:24
6	Name:Bhargav_In_time:20:47:08_Date:25-02-2023	02/25/2023	20:47:09
7	Name:Bhargav_Out_time:20:47:21_Date:25-02-2023	02/25/2023	20:47:22
8	Name:Snekanth_In_time:20:47:34_Date:25-02-2023	02/25/2023	20:47:35
9	Name:Snekanth_Out_time:20:47:40_Date:25-02-2023	02/25/2023	20:47:40
10	Name:Snekanth_In_time:20:48:19_Date:25-02-2023	02/25/2023	20:48:19

Showing 1 to 10 of 74 entries

Previous 1 2 3 4 5 ... 8 Next

Fig: 5.4: IOT Database

The data will be updated from the system on this IOT Page. Anywhere that has internet access can access this page. This is the IOT page, where we can see that the data log is maintained. Here we can see that the student's name along with his attendance date is time is mentioned. These data's are available on the online server.

CHAPTER 6

SUMMARY AND CONCLUSION

This report shows the partial achievement of the project represents the positioning-based system to track the attendance of the student between each period of time within the range of circumference of the classroom or a lab. The algorithm is done in visual studio code by using the C compiler with the help of puTTY software. puTTY is a Powershell feature that enables one to communicate with two computers.

In visual studio code, the developed C program for the signals to be transmitted and received from the RSSI module using SSH (secure shell). When a loop program is added to receive continuous signals from the transmitter till the signal is lost (out of range).

The RSSI Module acts a major role in receiving the signals from the transmitter to enroll the student attendance for each of them who is present in the classroom of the circumference denoted.

However, there are also potential challenges and limitations associated with this system, such as those related to signal interference, signal attenuation, and device heterogeneity, as discussed earlier. Careful design and testing of the system would be necessary to ensure its reliability and accuracy in different classroom environments.

Initially, the indoor positioning system was studied and classified based on its factors, and then a vast literature study pertaining to the experiments conducted in the attendance system has been done. A review paper titled - RSSI Indoor Positioning Integrated Classroom Attendance System – A REVIEW, has been presented at a conference, and the proof of acceptance and the mail correspondence has been submitted including acceptance of Research paper conference.

The participation framework based on 2.4G RFID cards is portrayed in this article for understudies entering and taking off the school. This framework has been utilized in numerous schools for a long time and has worked relentlessly and successfully. The slightest squares method-based RSSI calculation is proposed, which can rapidly decide a student's status as they enter or take off school on a shrewd terminal, significantly diminishing the trouble of foundation information handling and altogether bringing down the taken toll of the whole framework.

We will to make equipment plan changes to streamline the establishment. This article introduces the RSSI card-based participation framework, which has been around for a whereas and may be a solid and effective way to track understudies coming in and going out of the building in numerous schools. It is proposed to utilize the slightest squares method-based RSSI calculation, which can rapidly decide a student's status as they enter or leave school on a savvy terminal, enormously lessening the difficulty of foundation information handling, and essentially bringing down the taken a toll of the complete framework. Ready to too progress equipment plan to create establishment simpler.

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ANNEXURE:.

- Presented the Review paper titled “ RSSI Indoor Positioning Integrated Classroom Attendance System-A Review “by J.SenthilKumar,P. Bhargava Rao, B.Snekanth at ICAARS 2022 conducted by PSG College of Technology, Coimbatore on 10th December 2022.
- Presented the Review Paper Titled “RSSI Indoor Positioning Integrated Classroom Attendance System-A Review” by J.SenthilKumar, P. Bhargava Rao, B.Snekanth at ICCRAME 2023 conducted by Ramco Institute of Technology , Rajapalayam on 25th March 2023.
- Presented the Research Paper Titled “RSSI Indoor Positioning Integrated Classroom Attendance System” by J.SenthilKumar, P. Bhargava Rao, B.Snekanth at ICDTM-23 Conducted by Sastra University, Thanjavur on 9th April 2023



Department of Robotics and Automation Engineering

PSG College of Technology

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**Third International Conference on
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(ICAARS - 2022)**

CERTIFICATE

This is to certify that Dr./Mr./Mrs./Ms. *Bhargava Rao* has presented a paper in the technical session on *10.12.2022* entitled *RSSI Indoor positioning* *Integrated Classroom Attendance system - A Review* in the Third International Conference on Advancements in Automation, Robotics and Sensing (ICAARS 2022) organised by the Department of Robotics and Automation Engineering, PSG College of Technology, Coimbatore during 9 - 10 December 2022.

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Integrated classroom Attendance System - A Review in the Third
International Conference on Advancements in Automation, Robotics and Sensing
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UG STUDENT, SCHOOL OF MECHANICAL, SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY has presented a paper titled "RSSI INDOOR POSITIONING INTEGRATED CLASSROOM ATTENDANCE SYSTEM – A REVIEW" in the International Conference on Contemporary Research Advancements in Mechanical Engineering - 2023 (ICCRAME 2023) organized by Ramco Institute of Technology on 24th & 25th March, 2023 through online.

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RSSI Indoor Positioning Integrated Classroom Attendance System

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Abstract. To improve school administration of understudy participation, a number of understudies enter the course and exit from there based on the 2.4Ghz card have been created. These frameworks making utilize of the RSSI strategy and back-end server innovation. The current situating strategy regularly made utilize of the RSSI-based remove fitting show. This model is very accurate, but the accuracy of the results of the calculations is greatly influenced by the environment, and a lot of data is needed for the calculations. The complexity of calculations is regularly expanded by the have to be transmit information handling exchange from the terminal to the server. The no-interaction school participation strategy that's recommended in this paper makes utilize of Wi-Fi 2.4GHz Gotten Flag Quality Marker (RSSI) values. A understudy is considered to be display in case they are near to peers who are selected within the same lesson and missing in the event that they are not. Utilizing this approach, participation recording is surrounded as a twofold classification issue. In arrange to form a novel include vector that might anticipate where a understudy would be in a classroom, RSSI groupings were utilized as the time arrangement input to parallel classifiers. This is accomplished by using the RSSI Algorithm. The VB Software in the system is receiving the data. From there, it is sent to the IOT Page, where the data can be viewed no matter where you are in the world. With the help of this project, smart software will be possible, and student tracking will be simpler. If they attempt to leave and use a proxy, the software will automatically mark them as absent. The data can be tracked by the parents as well with the help of IOT.

Index Terms—Attendance System, RSSI, Visual Basics, IOT.

I. INTRODUCTION

According to some studies, managing attendance is crucial to the operation of schools. The entire attendance has a top priority for entering and leaving the school. Statistics on students entering and leaving the school have an impact on daily disciplinary procedures as well as helping to ensure students' personal safety. Every school places a high value on students' attendance when they enter and leave the building. Currently, the following issues are the main ones:

(1) The understudy union officers count the number of understudies who arrive or withdraw from school at the desired time and provide the insights to the head educator beneath the understudy cadre on-duty framework. Utilizing the measurable discoveries, the head instructor affirms the number of truants and distributes a list of non-attendants. This prepare is time-consuming and labor-intensive.

(2) Every student who enters or leaves the building is recorded by the attendance software. When understudies arrive or take off the school at the same time, there's a issue with the attendance innovation, which can cause a swarming of understudies at the school door and uncover understudy security.

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