UHF RFID based Attendance using Node.js API, MongoDB and Vue.js

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Abstract :

Knowing resources we have is always makes our planning better and same can be said for the human resources. If we know the number of personal present at a particular time we can plan any activity related to that like their accommodation and food .Here comes the importance of attendance or in other words we can say how many personal are present in the organization at present .The role of attendance can not be ignored and the traditional way is not efficient enough to keep things in order.

Due to Covid19 virus we have challenge to design a contactless and easy hassle free attendance system which increases the degree of automation to an organization. Most of the solutions are biometric or close range RFID solution which is not having 1 Meter (2Gaj ki doori). For maintaining proper distance and keeping above things in mind we tried to implement a system which is scalable, fast and user friendly to the larger organization we proposed an UHF RFID system with Node JS API. We used API because of the services which can be consumed by the web and mobile application in future and can be easily extendable. The system has been implemented and tested and results are pretty encouraging to implement it for large scale.

IndexTerms **- Attendance Tools, UHF RFID, NodeJS, MongoDB Database, Raspberry Pi,VueJS**

I. INTRODUCTION

Attendance System is always been a critical and time intensive task for any organization. Attendance at every organization is always been a tedious, and time intensive task for organization and Authorities. If we go through the whole manually, the procedure can be labor intensive and full with errors. There are various automated systems are available to ease this; however, they can be very expensive and complex. RFID, an automated identification technology, which is economical and simple solution. The use of RFID to identify attendees and RFID scanners to capture the data makes accurate attendance tracking fast, feasible and reliable for organization.

Attendance is very important part of any organization for administration and we can able to plan with that the other activities. If we know the Teachers present at any particular day then the activities like organizing class or rescheduling them can be planned according to that for the efficient management of the institutions.

Traditionally the attendance took almost 20 % of the time for an average class which increases with the number of students and along with that the change of proxy attendance and mistakes also increased. That time can also be used for any other activities like double session etc. If any institutes have provision of marks or exam associated with the attendance then it is an important factor. Various study shows correlation between attendance and performance.

D. Moldabayev [10] indicates a strong relationship between overall semester GPA and overall student attendance.

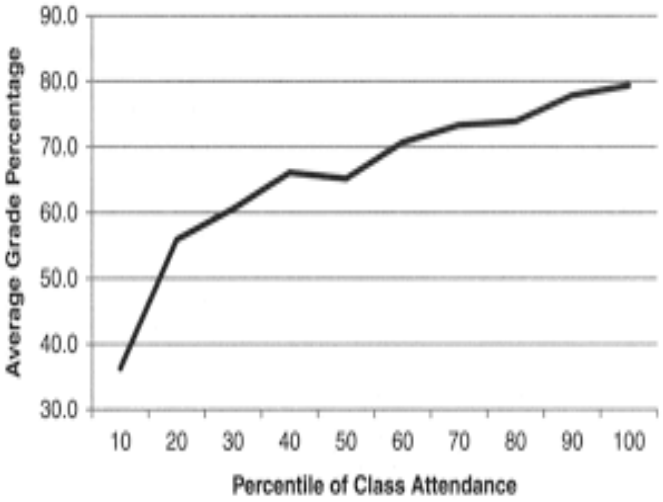

Figure 1 The relationship between grade and attendance

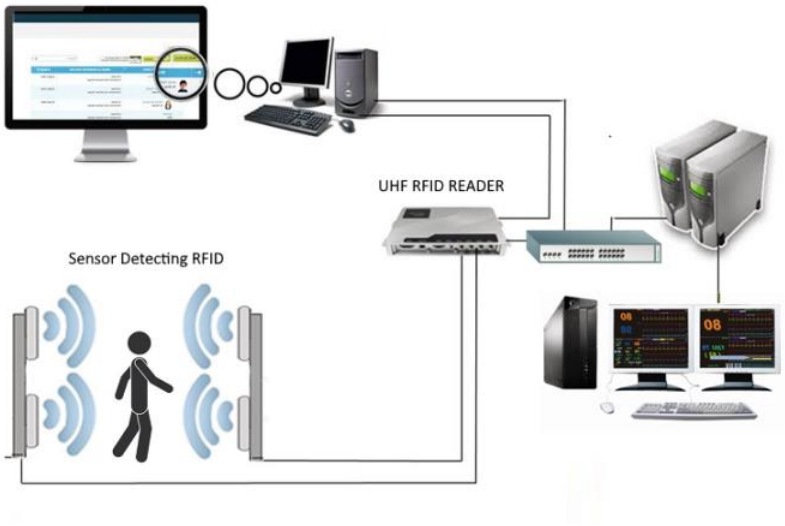

Figure 2 The Proposed System

Fig. 2 shows the proposed solution of attendance system where a personnel enters the gate and UHF reader send data to the Node JS application and insert attendance in the database .We can send SMS using the promise request and without waiting for the response the Node JS server will ready to accept the new RFID request .This will make the attendance faster than the traditional server based on different programming languages like VB.net, PHP. The SMS here added as add on features which mean to ensure the availability of the persona in the particular place.

II. LITERARURE REVIEW

To make a better attendance system .Fingerprint based attendance system are not considered efficient and after post COVID era it is not also considered safe as obvious reasons.

There are various studies have been done in that past regarding RFID application and its use as an attendance system. Most of the solution are provided here by author [1][4] is using 125KHz frequency RFID card which having limited range (15 cm) and out main aim is to maintain distance among students or persons .The research also suggested the visual basic as an interface which might lead congestion when using with SMS gateway. We also don't want to implement biometric system [2] which is not considered safe after Covid era and it is also time consuming process, here authors recommended a model of safe and convenient embedded reader system to read biometric data from electronic passport. In [3] author suggested Microsoft Access as a backend along with 125 KHz frequency RFID card .That lead the distance issue and Microsoft Access is not supposed to used with web based application because its elements are only functional in a Windows environment and are not well-suited with an internet browser like Chrome and Internet Explorer. The Access Jet database which is used by Microsoft Access is file based system and does not contain the server features that are available in Database Server like MSSQL, Oracle or other ODBC compliant databases.

U. Koppikar, has proposed their work titled "IoT based Smart Attendance Monitoring System using RFID,"[5] The author used RC522 module Reader for RFID which is having very less Working frequency and Card reading distance. Besides that, XAMPP application is choose because it is free and open source server package that include Apache, PHP, and MySQL database [6].

We need an simple system in which user doesn't have to wait in long queue which are efficient, fast and contactless which need one time setup only, here UHF RFID fits good in our requirements.

2.1 NFC vs RFID and BAR Code System

Specification	NFC	RFID	Bluetooth
Coverage Range	**10 cm**	**3 Meter**	**100 Meter**
Frequency	**13.56 MHz**	**Varies**	**2.4 GHz**
Communication	**Two Way**	**One-Way**	**Two-Way**
Data rate	**24 Kbps**	**Varies**	**22 Mbps**
Application	**Credit card, payment Ticketing, Booking**	**E-pass, Tag, Vehicle, Inventory**	**Communication between Phone,**

Table 1 Comparison between different technologies

III. TECHNICAL IMPLEMENTATION

3.1 Hardware

For implementing it we have taken Ultra High Frequency (433 MHz, 860-920 MHz) RFID card which is having reading distance over 10 feet and along with that we took and UHF RFID reader which is connected through the system with Ethernet card and send data to Node.js API which captures the request and process the data and save it to the MongoDB database.

For this purpose we used Raspberry Pi along with FM-503 RFID reader which is a UHF reader with read range of 5 Meter additionally it having 4 Port for antennas and built in compliance with ISO18000-6C EPC Class 1 Gen2 standards. It is able to read the Frequency 840-960 MHz RFID cards which fulfill our need of the project.

3.2 Node JS Application

Node.js language is asynchronous which means the JavaScript engine runs through the whole code in one go and does not wait for response for the function. It uses event-driven non blocking Input/ Output execution model. In Node js the function will execute and without waiting for the response Node js will ready to accept the new request and once the function return the output it displays the result and thus it make Node.js fast and non blocking. Research proves that Node.js can handle IO operations exceptionally good [9].

Node.js shows better performance than the conventional server [7]. We are trying to achieve MEVN implement a Restful service for an Internet of Things [8].

We use Node.js for developing the API so that its services can be used by mobile application and web application. We are going to user JSON web Token to authenticate and body parser. So basically it will be a token based authentication. For front end we will be using Vue JS which is a progressive java script and it will communicate with the Node.js API.

3.3 MongoDB Database

Mongo DB is open source software and a primary NoSQL Database. Mongo DB in addition gives ACID properties at record level as on account of relational databases. MongoDB boost replication sets, i.e., the fail over mechanism is accordingly control by the MongoDB server. If the primary database server goes down, the secondary server takes place of the main server, without human intervention.

MongoDB as the database which falls in line with our objective to prove that MongoDB is faster than MySQL in loading data dynamically .[11] As a NoSQL (Non-Structured Query Language) database, one of MongoDB's important features is its schema-less or non-relational data structure. This allows for a huge degree of adaptability in keeping various data types and using them.

Versatility is especially significant nowadays with the commoditization of Big Data, which generated from innumerable dissimilar sources and doesn't always fall into neat category.

One advantage it has over MySQL is its capability to handle huge unstructured data. It is tremendously faster. People have achieved real time MongoDB performance since it helps users to ask in a particular way that is more open to workload.

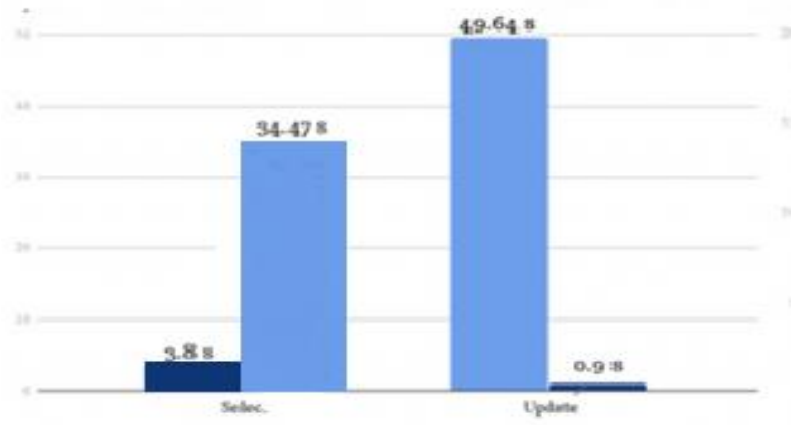

Figure 3 The Select and Update Operation in Mysql and Mongodb

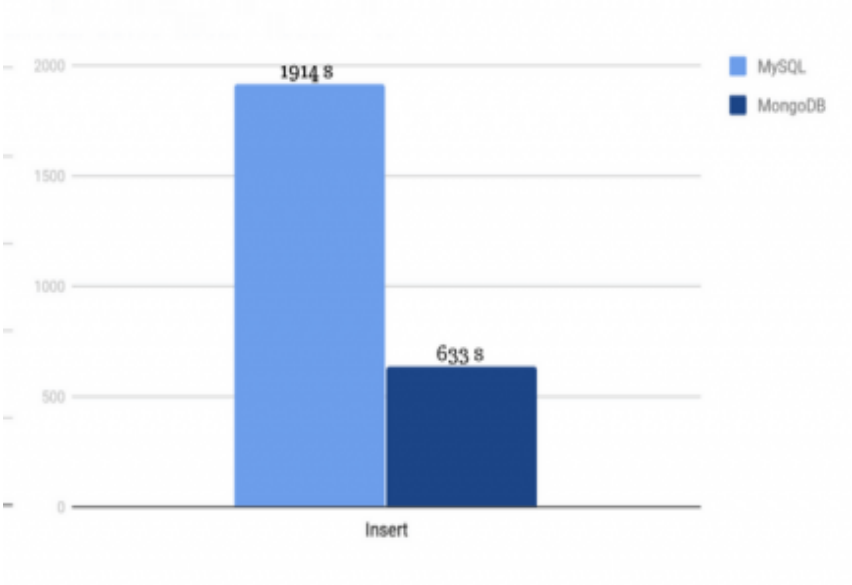

Figure 4 The Insert Operation in Mysql and Mongodb

It has been observed from the graph that MongoDB takes lesser time than MySQL for the same operations.

MongoDB uses a role-based access control with a flexible set of rights. Its safety features comprise of authorization, authentication and auditing.

We can use Transport Layer Security TLS and Secure Sockets Layer SSL for encryption. This makes sure that it can access and read by the desired person only.

3.4 Graphical User Interface (GUI)

We are using Vue JS for frontend which consume the REST API using axios package. We used async and promise based mechanism. On event emitter we can send SMS to the user or modify the data in the database. Vue.js enables two-way communication as it has MVVM (Model –View-Viewmodel Controller) architecture.

The propose system is having multiple role base authentication. There is Administrator role, user role and moderator role .User can view his attendance. Admin and Moderator can monitor the attendance.

Figure 5 Mongodb Snapshot of the database

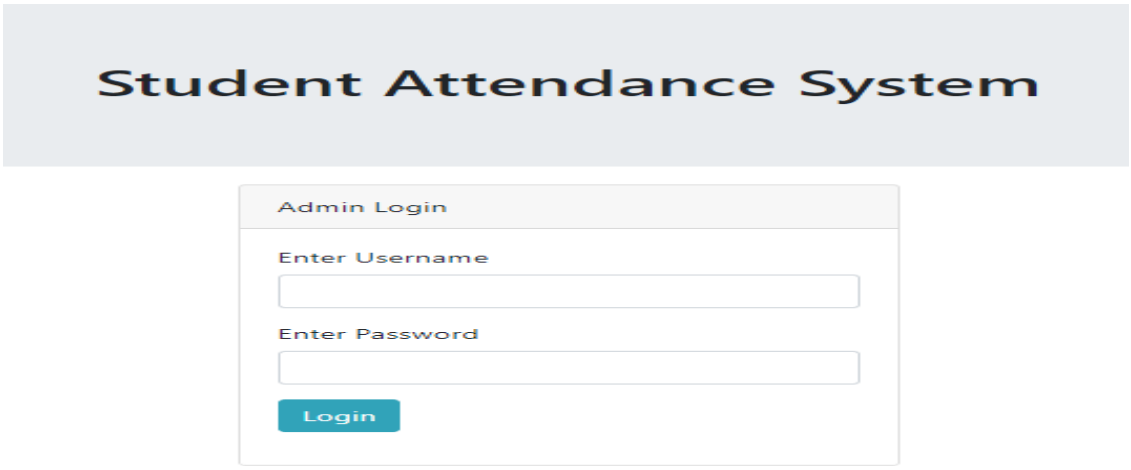

Figure 6 Login Screen

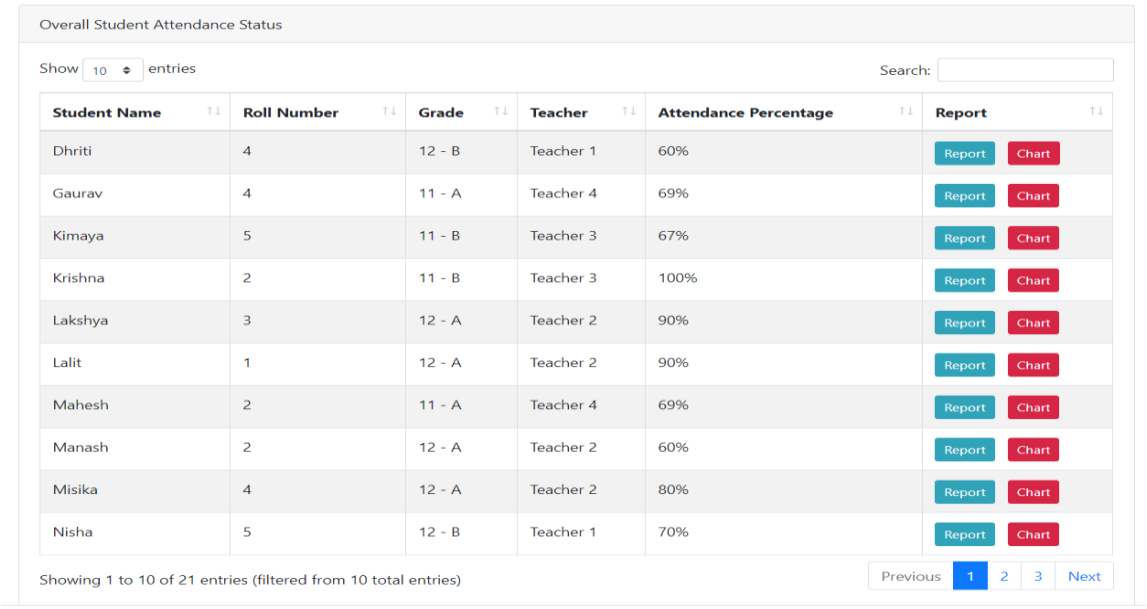

Figure 7 Attendance Status

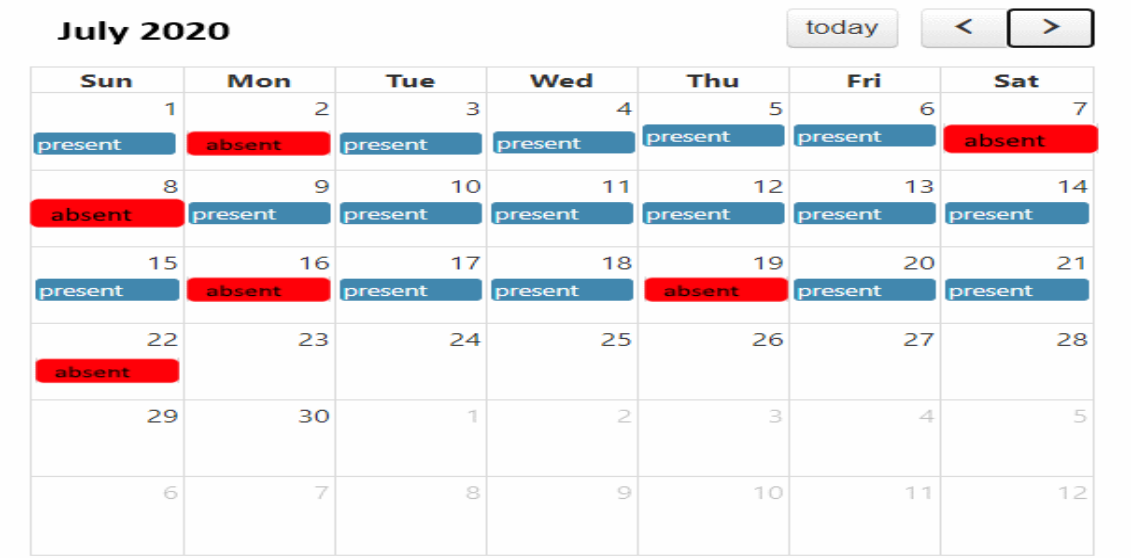

Figure 8 Attendance Calendar View

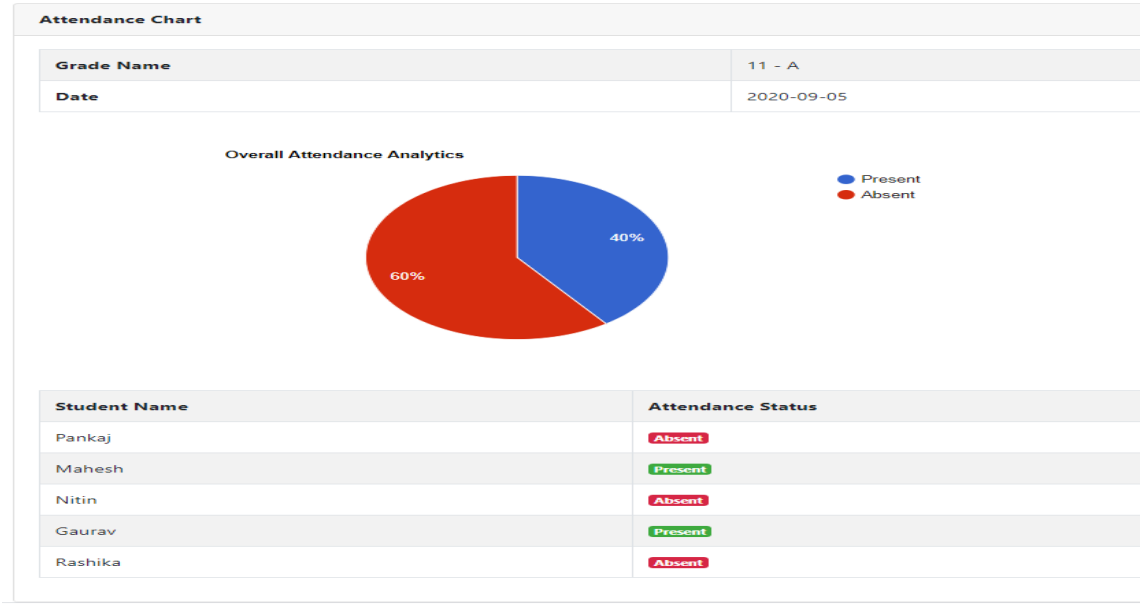

Figure 9 Attendance Administration Class

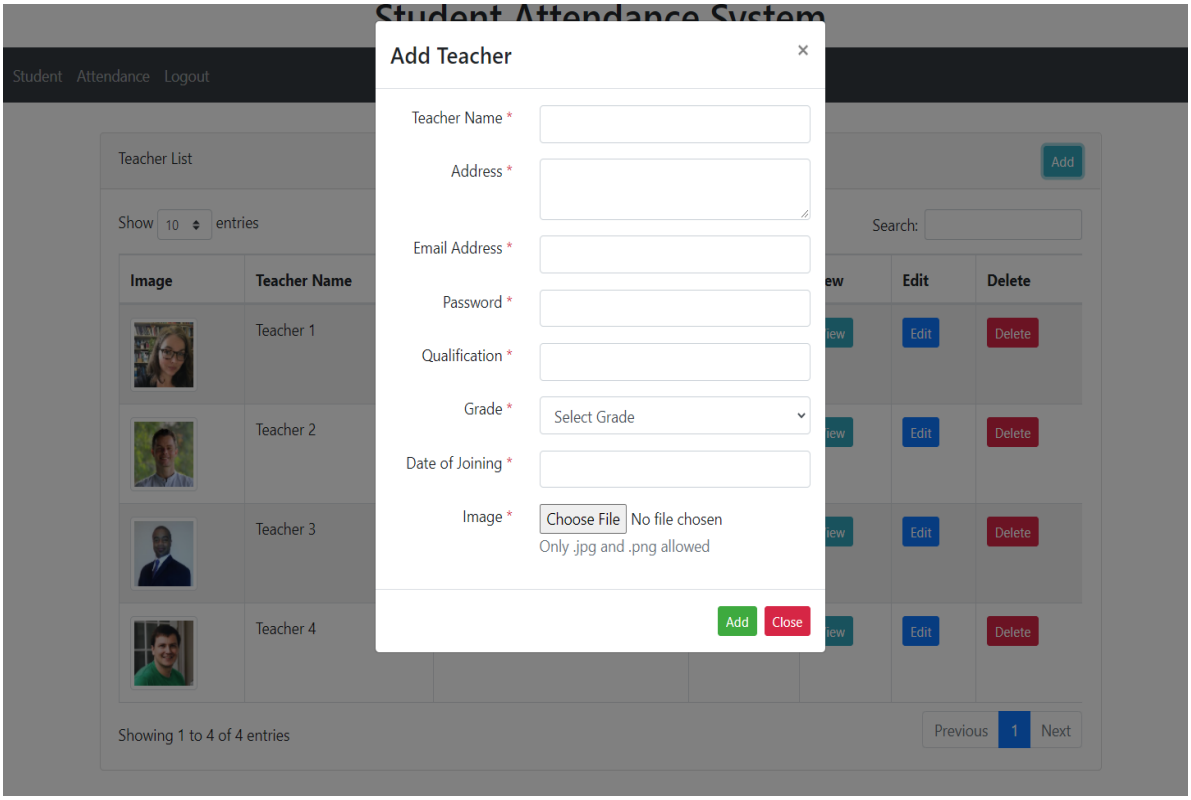

Figure 10 Teacher Addition

Attendance Report

Date - 2020-09-03

Student Name	Roll Number	Grade	Teacher	Attendance Status
Pankaj	1	11 - A	Teacher 4	Absent
Mahesh	2	11 - A	Teacher 4	Absent
Nitin	3	11 - A	Teacher 4	Absent
Gaurav	4	11 - A	Teacher 4	Absent
Rashika	5	11 - A	Teacher 4	Absent

Date - 2020-09-04

Student Name	Roll Number	Grade	Teacher	Attendance Status
Pankaj	1	11 - A	Teacher 4	Absent
Mahesh	2	11 - A	Teacher 4	Absent
Nitin	3	11 - A	Teacher 4	Absent
Gaurav	4	11 - A	Teacher 4	Absent
Rashika	5	11 - A	Teacher 4	Absent

Date - 2020-09-05

Student Name	Roll Number	Grade	Teacher	Attendance Status
Pankaj	1	11 - A	Teacher 4	Absent
Mahesh	2	11 - A	Teacher 4	Present
Nitin	3	11 - A	Teacher 4	Absent
Gaurav	4	11 - A	Teacher 4	Present
Rashika	5	11 - A	Teacher 4	Absent

Figure 11 PDF Report of Attendance

IV. SYSTEM TESTING AND RESULTS

The RFID technology implementation has certainly makes the entire of process of marking attendance faster. The conventional method of attendance involves individual manual entry which itself is a laborious and a time consuming process.
Here is the comparison with the result of study which we tried in that school

Method	Total Number of Students			
	10	**30**	**50**	**100**
Manual Entry	**80 Seconds**	**240 Seconds**	**400 Seconds**	**800 Seconds**
Bar Code	**18 Seconds**	**54 Seconds**	**90 Seconds**	**180 Seconds**
RFID Technology	**1 Seconds**	**3 Seconds**	**5 Seconds**	**10 Seconds**

Table 2 Time taken by using different methods

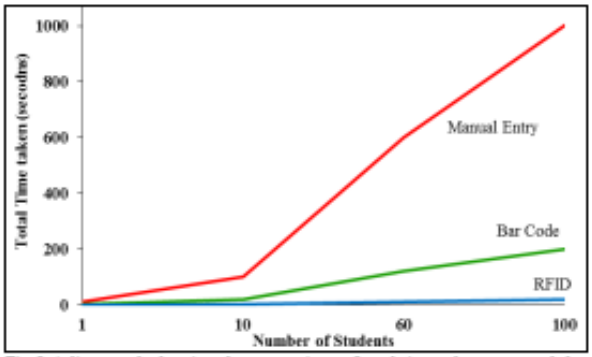

Fig 8 A line graph showing the comparison of total time taken to record the attendance of students.

Figure 12 The Graphical Representation in time taken using different technology

As shown in table, compared with the time consumption in attendance for different technologies, RFID saves significant time and greatly enhance the efficiency. Also with the embracing of this technology the process and quality can be enhanced due to reduction in entry errors by manual human operations.
The similar result have also been shown by the in paper "RFID Technology Based Attendance Management System"[12] and some other papers[13].
The web interface gives better clarity of the attendance registered and also helps in generating reports as and when needed. The core feature of the smart IoT based attendance monitoring system is that, the administrator can access this data, anytime and anywhere. This helps the administrator to have a control over the attendance management without the need of being physically present at the location. The proposed system is tested with different RFID cards and RFID tags and is successful in recognizing the RFID cards that are registered. The system is tested for all the conditions with two RFID numbers. Following test cases were subjected to the system and the results obtained were noted.

V. CONCLUSION AND RECOMMENDATIONS

The project has been implemented in the school for testing purpose and the results were fascinating. The administration having less burden with the attendance now and they can utilize the time in other recreational activities .Staff is also having their RFID tags and now the management is planning to link it with their payroll module. With the use of SMS gateway now parents can confirm the safe arrival of their minors. We have achieved a solution based on technology which completely contactless and requires no operator once implemented. The proposed system is time-saving, user-friendly and reliable to use.

VI. REFERENCES

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