A Unified Artificial Intelligence Framework for Enhancing Multi-Modal Accessibility and Inclusive Pedagogical Environments in Modern Digital Classrooms

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ABSTRACT
A Smart Classroom Management System uses intelligence to make schoolwork easier, for teachers, students and parents. The Smart Classroom Management System has pages for each group to see what they need to do. Teachers can. Check quizzes using Gemini AI on their page. They can see who is coming to class, who is sharing and how the quizzes are going. The Smart Classroom Management System helps teachers make quizzes faster. It makes sure students get their schoolwork away. Students can take quizzes check their schoolwork and ask for help from an AI Doubt Solver on their page. This lets students work on hard problems and learn at their own speed. Parents can also check if their child is coming to class how they are doing on quizzes and how they are doing overall. The Smart Classroom Management System helps everyone talk to each other. When everyone can see what is happening it is more fair and clear. It also helps people make decisions based on what works and what does not. The Smart Classroom Management System wants to use intelligence to make school better so students can learn and have fun. The Smart Classroom Management System promises to make it easier and more fun for teachers, students and parents to work together. Help each other out. The Smart Classroom Management System is really important because it uses intelligence to make school work better for everyone.

Keywords
Natural language processing, educational technology, generative AI, smart classrooms, accessibility.

1. INTRODUCTION
Artificial intelligence has really changed the way people learn nowadays. It helps make learning more personal by using systems that can adjust to how each student learns. This means that Artificial Intelligence can be used to create tutoring programs, grade tests and give students feedback that is just for them. Some studies have shown that using Artificial Intelligence in education can make learning more interesting and help students do better in school. These studies found that Artificial Intelligence can look at how students learn and what they're good at and then use that information to create a learning plan that is just right, for them. Artificial Intelligence can really help improve education by making sure each student gets the help they need to succeed [1], [2]. Classrooms that use intelligence and machine learning are really helpful. They help teachers watch what is going on in the classroom at that moment. These smart classroom models also use tools to predict what will happen next and to make decisions based on data. This changes the way of teaching, into a new and intelligent way of learning. The classrooms become smart. Can even help teachers make good decisions. Smart classroom models are very useful because they use intelligence and machine learning to make the classroom a better place to learn [3], [4]. People are discussing about how AI can make learning easier for everyone. Artificial Intelligence can create a learning space that's fair and works for students who learn in different ways and have disabilities. This is because Artificial Intelligence can give them the learning materials at the right time, which is really helpful for students, with special needs and disabilities. Artificial Intelligence does this by giving them content, which means that the learning materials are made to fit each student's needs [5], [10].

These new developments are great. Most educational platforms do not work well together and they do not use Artificial Intelligence in a big way to help with daily classroom work. Google Classroom and Moodle, for instance, are mostly used to give out homework, grade work, and share resources. They do not do much to help students in real time or make things easier with automation. They are missing things like quizzes that can be made by Artificial Intelligence help with questions away and ways to predict who will be in class. They also need a place where everyone involved can see what is going on. Teachers like systems that can do tasks on their own and also give them useful information to make their teaching better. Artificial Intelligence can really help with this. Educational platforms need to use Artificial Intelligence to make things easier, for teachers and help students learn better [6], [7]. Studies, on education systems that use Artificial Intelligence show that most of the time they do not put together analytics and assessment tools and

features for parents to get involved and smart ways to keep an eye on things. Artificial Intelligence based smart education systems need to have all these things working together. Education systems that use Artificial Intelligence need to bring a lot of things. They have to put analytics and assessment tools and features that get parents involved and smart monitoring, into one system that is easy to understand. Artificial Intelligence based education systems should have all these things in one place. This means Artificial Intelligence based education systems should have analytics and assessment tools and parental engagement features and intelligent monitoring together [8], [9].

A classroom platform that uses AI to bring together all the features it needs is needed. It should have features like quizzes and special sections for students. The platform must keep track of who's in class. It should give us updates on how things are going in class. This platform will help you manage your classroom efficiently. It will use intelligence to make your teaching easier. A system is needed that helps each student in a way that's just right for them. The new platform is supposed to fix the problems currently faced by teachers, students, and parents by giving them a place to go. This place should make it easier for everyone to talk to each other and understand what is going on. It should make everything work better. Help people learn more. The classroom platform should be easy to use and help us make decisions based on the information received from it.

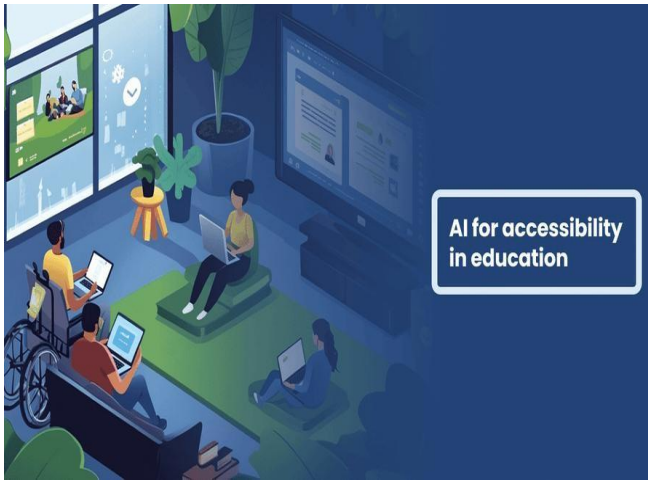

Fig 1: AI for accessibility in education

2. LITERATURE REVIEW

"Artificial Intelligence in Education: Opportunities and Challenges" by Sharma, S. K., & Kumar, A. Artificial intelligence is playing a bigger role in education. How AI is making it easier to teach. Helping students learn more. These people are called the writers of this, and they say that Artificial Intelligence makes personal learning, automatic kinda grades to do by themselves and assistance for students from computers. That means teachers must do some work and students want to be engaged. Artificial Intelligence should be utilized to enhance education in a novel, unconventional manner, distinct from the current norm. This will help everyone learn more easily. AI personalizes learning it lightens the burden of teachers. It makes grading more accurate. AI needs a lot more computing power than regular programming on the servers the team have now. There are also concerns, (even) over student privacy [1].

"Smart Learning Environments Based on Artificial Intelligence: Review and Outlook Artificial intelligence improves learning" by Hwang, M. J. It demonstrates how certain platforms are able to analyze student behavior and adapt learning material to their speed and ability. The study says this simplifies the process of delivering educational information in an alternate way to each student as AI helps students with their learning through personalized practice. AI is tailored to learning, customizes teacher instruction and motivates students. It requires some decent technology to make it work but not everybody in the developing places is able to use it [2].

"AI-powered smart classroom solutions make teaching and monitoring easier" by Chandra, R., and Singh, P. Technology that automatically registers attendance, tracks student progress and evaluates learning can make classrooms smarter, the authors believe. As per this study, Artificial Intelligence assists teachers in handling classrooms and provides more time to focus on teaching. This allows teachers to keep an eye on what goes on in the classroom and evaluate student performance. The classroom structures can also be self-running. But establishing these systems is complex. And, to keep them running, you need to know a lot about technology [3].

"An Intelligent Classroom System Using IoT and Machine Learning" by Wang, K., Li, L., and Chen, Z. The last classroom. This is enhanced with the IOT and machine learning. This system gets data from the classroom in real time. It assesses student engagement and culture. Data-driven theories are changing the way things work and structures set up with the aid of Internet of Things devices and AI make decisions based on performance and enhance college experience. Yet there are still problems figuring out its effectiveness." It can track what is happening in classrooms, utilize resources efficiently, and enhance learning. But there are issues. IoT devices are security risky. This technology comes at a high cost in the classroom [4].

"How Artificial Intelligence Is Transforming Education: A Review of Current Applications and Future Prospects," by Almarashdeh, S. Intelligent assessment and automated tutoring are two useful AI tools for schools. AI learning platforms are included. The study indicates that AI assists students learning in ways that innovate education for all and everyone. Academically struggling kids can use AI. Teachers and parents can collaborate better. AI facilitates education. It also enables teachers give kids constant feedback. People worrying about right and wrong and AI systems not understanding how people feel are issues with AI systems. AI-powered tutoring can benefit education. AI systems' lack of emotional engagement and ethical issues must be considered [5].

"Integration of IoT and AI for Smart Education Systems" Gupta, A. K. AI and IoT in classrooms are fascinating. The Internet of Things and AI can improve education. AI and the Internet of Things (IoT) can help you keep track of how many students are there, how well they are doing, and what they are learning. It can make school easier. Make their work better. AI and the Internet of Things can help schools make good decisions, collect data, and automate tasks. There are problems with keeping the network running and everything else running smoothly. Artificial Intelligence and IoT can improve education [6].

"Design and Implementation of AI-Based Smart Classroom Management System" by Lin, J., and Zhang, Y. This intelligent classroom management system. It tracks student progress and makes judgments automatically. The creators of this technology demonstrate how it helps teachers track student progress and identify learning issues. This technology also improves communication amongst education stakeholders. Improves classroom efficiency. It eliminates paperwork, streamlines the classroom, and gives teachers immediate student information. This system needs constant updates to work. Training is needed for users [7].

"A Conceptual Framework for AI and Big Data in Smart Education Systems" by Rajendran, S. The report says that AI and Big Data can help teachers do their jobs better. It tells you how to look at a lot of data to figure out how well students will do and what they are interested in. This research helps make it possible

to plan for school and give personalized lessons. Data can be used to predict student performance, making academic planning and teaching more effective. However, data management is difficult. Protecting student data is important [8].

"Deep Learning in Smart Education: A Comprehensive Survey" by Huang, T. et al. This survey examines educational technology's deep learning application. The authors discuss intelligence models used to automatically recognize speech, grade work, and study learning. Deep learning approaches improve tutoring systems and classroom tools, according to the study. Deep learning is good at predicting information and testing pupils fairly. To do deep learning, you need a lot of data and advanced machines [9].

"Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development" by UNESCO. This report looks at how AI is being used in schools around the world and how it affects the goals of making the world a better place. It talks about making sure everyone can learn no what and that education is fair for all people using smart systems. The report stresses the need for AI-based education systems that connect students, teachers, and parents all over the world to help them learn. Artificial Intelligence helps make education available to everyone in the world it helps people learn their lives and it makes education better. There are problems like the divide and people do not have the same rules for Artificial Intelligence everywhere, in the world [10].

3. OBJECTIVES

The main motto of the AI-Powered Accessibility Enhancer for the Classroom is to design an intelligent, user-centered platform that will automate and ease academic tasks among teachers, students, and parents. This system takes over quiz creation, lifting some of the load off teachers and letting them focus on what matters most—teaching. Tasks not only but smarter learning, attending, and performance analysis are also handled by AI, which analyzes performance of children in real time, as soon as they start working on tasks. Whole learning gets simplified for all users, including teachers and parents, with a personalized dashboard being offered to them. Even communication gets simplified with personalized learning for students.

Everthing related to the class, such as homework, presence, and analysis, is under one roof. The days when a student had to move from one software to another to see what is happening in class are over. The most relieving part is they get assistance pertaining to AI, which enables them to gain knowledge faster and better. They can gain knowledge from everywhere and at any time. Custom tests? Done. Instant feedback? That's built in, along with an AI-powered doubt solver.

Parents do not get left out either. They can check their childs grades and attendance. See how they are doing whenever they want. This makes it easier for parents to talk to teachers about how their child is doing in school. Everyone is able to stay on the page. The digital learning system is where everything comes together. It is easy to use. It helps people make smart choices based on facts. The system is accessible. It is intelligent. It helps each and every person make decisions about digital learning. The system does not just keep up with education. It actually sets the pace for education. Digital learning is what this system is about. It supports each and every one of the parents and teachers and students in making decisions about digital learning based on real data, from the system.

4. PROPOSED SYSTEM

The school is using intelligence and cloud solutions to make a special dashboard for teachers, students and parents. This means teachers will have a lot of tools to work with. They can use intelligence to make quizzes upload content track students and keep an eye on who is enrolled. All of these tools will be in one place. This is really good, for kids because they can take quizzes share their work and get their grades away. They can even ask questions. Get clear answers. The school is not forgetting about parents. They will get to see how their kids are doing by looking at attendance records performance charts and their latest work. The artificial intelligence will do a lot of the work. It will help quizzes make learning materials and observe patterns in how students learn. The artificial intelligence will help teachers and parents understand what is going on with the kids. The school is using intelligence to make sure kids have a good education and that parents are involved.

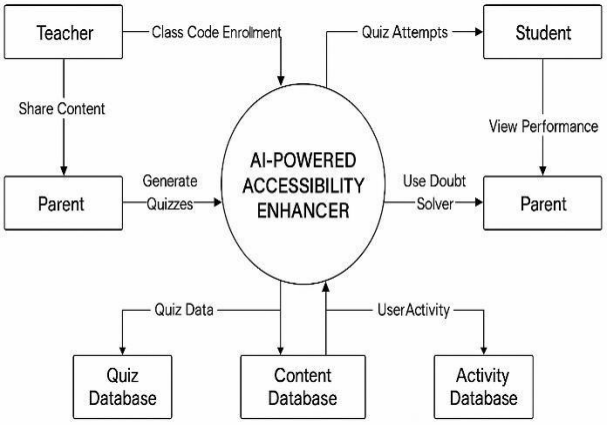

Fig 2: Proposed System

5. METHODOLOGY

5.1 Requirement Analysis

They began by figuring out what teachers, students and parents really needed. They did this by watching how teachers, students, and parents used the systems they had and seeing what was not working well. Teachers needed help with managing quizzes tracking how students were doing and managing materials, which meant they wanted to do busy work. Students just wanted to be able to get to quizzes get feedback right away and have their questions answered. They were interested in AI. Parents wanted to get honest updates on how the children were doing. The team also needed to make sure the system was secure, always working, easy to use, and able to handle a lot of information. The needs of teachers students and parents drove how the developers built each part of the system. The system was built to meet the needs of teachers, students, and parents.

5.2 Design Phase:

The system design is made up of parts that all work together. The designers used diagrams to show how it all works, like use case diagrams, DFDs, activity diagrams, and system architecture models. The system design has three parts: the front part that people see the middle part that does all the work with the help of Artificial Intelligence and the back part that stores all the information on the cloud. The DFD Level-0 diagram shows how parents, students, teachers and the Artificial Intelligence engine talk to each other. Then there is the Level-1 diagram that breaks down what happens inside the system into steps. The team made sure that the interface is simple to use and find your way around. The system took things like quiz management, attendance, and performance analytics. Made them into simple steps that people can follow. The system design is really about making it easy for people to use the system and get what they need from it. The developers used Artificial Intelligence to make the system smarter and more helpful to people. The Artificial Intelligence makes the system design better and more useful, to people who use it.

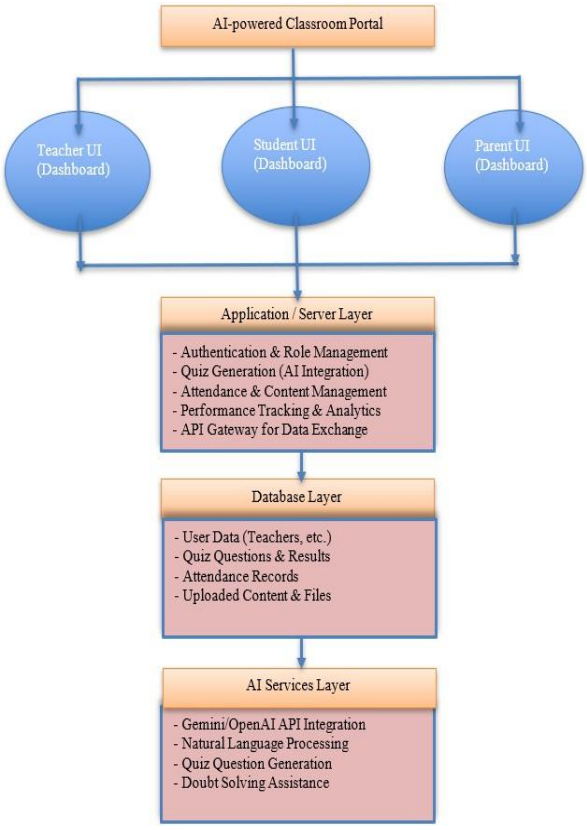

Fig 3: System Design

5.3 Development

1) **Front-End Development**
The team built part of the website using React Native and React.js. This means each person whether they are a student, a parent or a teacher gets their special page that is just right, for them. The developers used Tailwind CSS to make it look good. The team also made their own special parts to make sure that everyone can use the website easily. For keeping track of how people are doing, the system added special pictures that show information in a way that is easy to understand so students and parents can really see how the students are doing with the website.

2) **Back-End Development:**
The backend runs on Node.js with Express. It uses APIs to handle things like authentication quizzes, solving doubts, and dashboards. The system was connected to the Gemini AI model. This helps generate quizzes and process smart content. The backend talks to the database. It stores user information, statistics, files and quiz results there. The database stores everything, about the user. This includes user info, stats, files and quiz results.

3) **Development Tools**
The developers used Visual Studio Code to write the code for Postman so they could check the APIs. The team also used GitHub to keep track of the changes made. The developers used the browser tools to find problems with the user interface and fix them. The team wrote the code for the frontend and the backend of the application in JavaScript and TypeScript. The developers did all the coding with JavaScript and TypeScript on both the frontend and the backend of the application. JavaScript and TypeScript were the languages used to write the code for the application.

4) **Database**
The team picked MongoDB and Firebase to take care of the quizzes, attendance, submissions, shared resources, user roles and the classroom data. This works out well because MongoDB and Firebase keep all the data in sync at the same time. When more users join, MongoDB and Firebase can handle them. MongoDB and Firebase are working together to keep all the data up, to date with MongoDB and Firebase.

5.4 Testing

The developer tested everything step by step. The team ran tests to make sure that each part of the system worked on its own. After that, the developer made sure that all the parts, like the frontend, backend, and AI, worked well together. The team also tried it out with teachers, students, and parents to make sure it went smoothly. The group made sure that the dashboard was useful and easy to use because it was important. They also made sure that everyone, including people with disabilities, could use it easily. The information had to be clear. The system had to be fast. When the team tested how well the system performed, the AI created quizzes quickly. The database worked fine even when many people used it at the time. By the end of testing everything worked as it should. The analytics were accurate. People could use the system without issues. The team tested the AI and the system together. They worked nicely. The dashboard was helpful and easy to get. The system was fast.

5.5 Deployment and Maintenance:

The team set up the system on cloud platforms like Firebase, Render and Netlify. This way the finished system stays up and running. It is easy for anyone to access the system. The system has secure sign-ins. The system has real-time connections between the modules. The real-time connections are built into the system. When it comes to maintenance of the system, the team does not just leave the system alone. The team upgrades the Artificial Intelligence models in the system. The team monitors how well the system is performing. The team fixes problems with the system as they happen. The team also listens to what the users of the system have to say so updates can be made to the system. This means there is a guarantee that everything in the system is working properly, that the system is reliable, and that the system with the Artificial Intelligence models is always ready to use in a classroom environment.

6. RESULT

The team started using the AI-Powered Accessibility Enhancer for Classroom. It is working really well. The AI-Powered Accessibility Enhancer for Classroom is popular with teachers because it lets them make quizzes in just a few seconds. They can also easily put class materials online. They can even tell who is in class and who did their homework. This is a lot faster than what used to be done. The team has a lot of quizzes now, and the AI-Powered Accessibility Enhancer for Classroom lets teachers grade them quickly and fairly. On one page, the teachers can see everything they need to know. They can see how many kids are in the class, who took the quizzes, and who came to class. The AI-Powered Accessibility Enhancer for Classroom makes everything easier. The AI-Powered Accessibility Enhancer for Classroom is also popular with the students. With the AI-Powered Accessibility Enhancer for Classroom, they can take quizzes. They can see how they did on

their own. They can also check their progress on their dashboard. They can easily use the AI-Powered Accessibility Enhancer for Classroom. The Doubt Solver is very useful. It uses AI to help students study at home. They can use it to go over something or to change something from one language to another. Parents like the AI-Powered Accessibility Enhancer for Classroom because it lets them see how their kids are doing. They can see if their kids are in class and how well they did on tests. If their kids need help, they can even talk to the teachers. The AI-Powered Accessibility Enhancer for the Classroom is doing its job. Now, the students, teachers, and parents are all on the same page. The AI-Powered Accessibility Enhancer for Classroom makes learning easier. The team don't have to do a lot of busy work. The AI-Powered Accessibility Enhancer for Classroom is useful. It makes things simple and clear. Students are figuring out how they learn. The parents are happy because they can see what's going on. Teachers like the AI-Powered Accessibility Enhancer for Classroom because it helps them do their jobs better. Everyone is happy with the AI-Powered Accessibility Enhancer for Classroom. Now, the AI-Powered Accessibility Enhancer for Classroom helps students, teachers, and parents work together.

Fig 4: AI-powered Accessibility Enhance for Classroom

The AI-Powered Accessibility Enhancer for Classroom has a nice main page. The blue highlights look great. They make the background look neat and professional. You have to choose who you are on the page. You could be a parent, a student, or a teacher. They give you these choices on cards. There is a picture, a description, and a button on each card that you can click to go where you want to go on the AI-Powered Accessibility Enhancer for Classroom.

This tells the system what you can see and do. Like a key, it opens the door. It's easy to read the page, and everything is in the right place so you can see what you need to do right away. The AI-Powered Accessibility Enhancer for Classroom is made to be simple to use and navigate. The AI-Powered Accessibility Enhancer for Classroom makes sure that everyone gets their own page that is only for them. The Classroom AI-Powered Accessibility Enhancer is easy to use and understand.

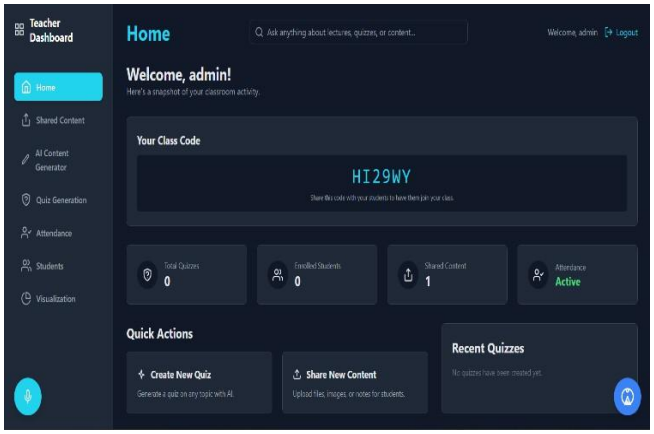

Fig 5: Teacher Dashboard

The teacher dashboard lets teachers keep track of what's going on in their classrooms. There is a menu on the side that makes it easy for teachers to find what they need. Some of the choices on this menu are Home, Shared Content, AI Content Generator, Quiz Generation, Attendance, Students, and Visualization. The main part of the dashboard greets the teacher. There is a search bar at the top that makes it easy for teachers to find quizzes, lectures, and other things they need for their students.

Under the part that says "hello," there are cards that have information about the classroom. These cards show things like how many quizzes the teacher has made, how many students are in the class, what content has been shared, and whether or not students are going to class. Teachers can make quizzes and upload things right away using the Quick Actions feature on the teacher dashboard. There is also a part that shows quizzes that were made not too long ago. The teacher dashboard makes it easy for teachers to see what's going on in their classroom and keep track of everything in one place.

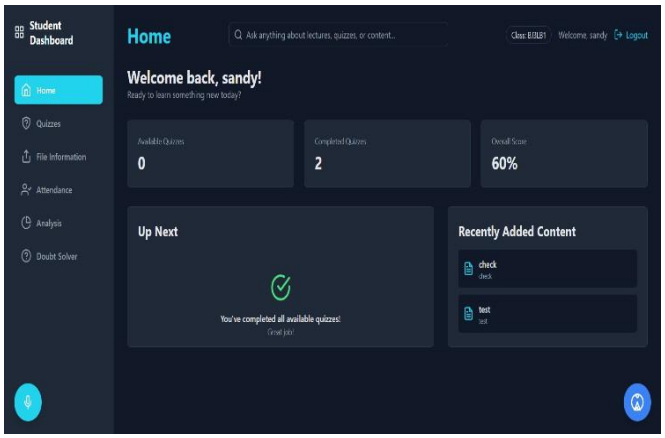

Fig 6: Student Dashboard

The student dashboard is like a page that shows you how well you're doing in school. On the side, there is a menu with options like Home, Quizzes, and Attendance. It says hello when you go to the homepage. It tells you how many points you got on your quizzes and how well you did.

There is a part that tells you what to do and another part that shows you what's new. The student dashboard is designed to help you learn on your own by making it easy to see how you're doing and find the things you need to learn. The student dashboard is set up so that the student can easily see how they are doing and what is going on in class. The student dashboard is set up so that the student can easily use it.

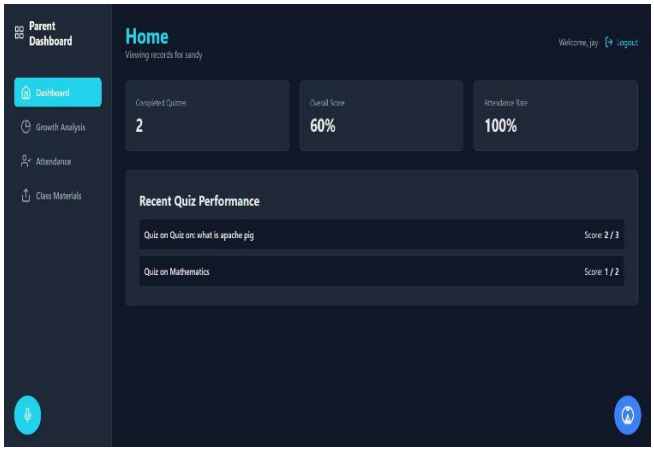

Fig 7: Parent Dashboard

Parents can use the parent dashboard to see how their child is doing. At the top, there are cards that show the student's overall score, how many quizzes they have finished, and whether or not they have been to class. These things help parents keep track of how their child is doing in school.

There is a part that shows how well the student did on the quizzes. It shows each quiz and the student's score so parents can see how well they are doing in each subject. There are links on the side to the Dashboard, Growth Analysis, Attendance, and Class Materials. These links make it easy to get around. This lets parents check on their kids' schoolwork. It's very easy to use. Parents can check on their kids' progress through the parent dashboards. Parents can use these dashboards to check on their kids.

7. CONCLUSION

The Classroom Accessibility Tool helps teachers keep track of their classrooms. The Classroom Accessibility Tool uses smart technology to make quizzes for the students and keep track of how well each student is doing. This lets teachers focus on teaching and helps students learn more. The Classroom Accessibility Tool also helps parents because they know that someone is watching over their kids while they are at school. The Classroom Accessibility Tool is made to change and grow with schools so that it doesn't become out of date. The good news is that it works. It's new to use intelligence in the classroom. It improves each student's education. It's not just a guess; it's based on real facts. The Classroom Accessibility Tool makes your teaching seem smarter and more useful for each student. The Classroom Accessibility Tool is a tool for teachers and students. It helps teachers teach better. It helps students learn more about the things they are interested, in.

8. FUTURE SCOPE

The AI-Powered Accessibility Enhancer for Classroom could eventually include advanced adaptive learning, immersive education using AR and VR, emotion-aware analytics, and offline support powered by 5G and edge computing. The goal of the system is to become a fully intelligent classroom assistant that provides personalized, inclusive, and real-time learning experiences based on data.

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