

Smart School Bag System Using IoT

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Abstract—The rise of tech has opened up new avenues for innovative solutions to some common day-to-day issues, students face. This paper examines the design and implementation of a novel Smart School Bag System with its focus on improving student safety, convenience, as well organizational efficiency. This system overcomes some of the issues faced with traditional school bags by incorporating GPS tracking, RFID tags, weight sensors and mobile app connectivity. This research correlates the conceptualization and prototyping of a smart school bag along with comparative assessment to ascertain user satisfactory performance. The result of both the test concludes that Smart School Bag System is very beneficiary and useful for organizing as well safety means.

Index Terms—GPS, IOT, Microcontroller, RFID, Smart School Bag and Student Safety.

I. INTRODUCTION

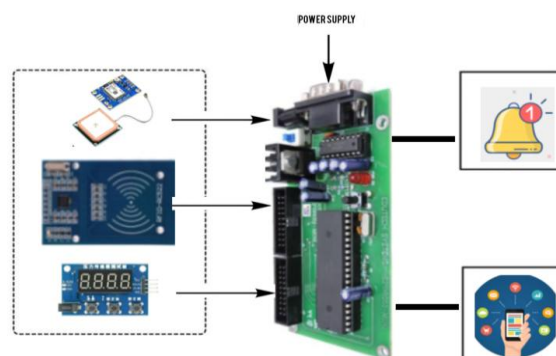
The Smart School Bag System represents a groundbreaking step in the modern application of technology into student life, solves many problems expected in usage of conventional school bags. Traditional book bags, though necessary for transporting books and materials to school, present a number of problems sore shoulders under the weight of some six textbooks, lost homework assignments because that paper plane wasn't put in this compartment or those pesky pencils wandered off into cavernous lining, doubt about whether your locker's level is zero even after they say so at freshman orientation. Our smart bag is the way out to all these problems a definite world of GPS tracking, weight sensors, digital timetable display and RFID technology with so many new visions. The Smart School Bag System contributes to the safety by tracking in real time location health, alerts for carrying excessive weight and forgetting items at home competitive activities with reminders for schedules [1-

2]. Among the most urgent is the literal burden of carrying heavy items. Studies have suggested that long term health problems are associated with heavy weight carried by school children in their bags like back pain, shoulder strain and posture related issues. Additionally, this disarray of papers is often a catalyst for forgotten assignments and lost school supplies two factors that encourage increased stress levels, as well as diminished academic performance. Another important concern is safety, especially among younger students who might be at risk of becoming lost or find themselves in a situation where they are unable to reach their parents. Discounting on traditional school bags, we need something smarter and techier [3-4].

II. SYSTEM UNDER STUDY

In this present research work, efforts are made to design smart school bag system using internet of things. Smart school bag system is useful for students as well as parents.

The following figure shows the block diagram of smart school bag using IOT.



In smart school bag system GPS tracking system, weight measurement sensor, time table display device, RFID system, Microcontroller and power management systems are playing important role. The details explanation of each part of block diagram explained below.

A. GPS Tracking

A system which incorporates GPS tracker within the smart school bag for enable real time location tracking of student by themselves (parents) or their concern like schools. This real-time position of the luggage will be transmitted constantly via its GPS tracking system to an integrated mobile app. With this, parents or guardians can track the movements of their children throughout the day so that they know always how he/she is placed. The GPS info can be accessed through a secure app which shows the location in map form with time-stamped updates or on demand. Basically, Geofencing is a fascinating feature that allows every individual to set specific virtual boundaries around the home area or school and even his/her respective bus route. This serves as an extra security blanket. the child does not leave, in areas they know are safe. This feature is especially handy for young children or anyone who travels alone [5]. In an emergency, the GPS system should be allowed programmed to send a distress signal with exact location details of where it is located to pre-set up contacts or even put across as far as sending out signals for help. This might be activated by the student them self or automatically triggered from certain events such as stepping out of a geofenced area Quick resolution which can greatly reduce response time and therefore save lives. A GPS tracking system is another great tool to help keep the children safe and provide real-time location data.

B. Weight Measurement

To avoid health challenges in carrying heavy load-burden due to deploying Weight sensors When the bag weight more, the smart school bag is two-way weight sensor monitors each time while Bag opens and detects excess loads that poses threats on either students or parents' side. The weight sensors will be built right into the smart school bag and they would evaluate an exact sum of how large or discreetly heavy something was inside a recipient. The sensors would be positioned at the bottom of the bag or inside its straps for best results. This information is then sent to a mobile app from which the student, and their parents or guardians, can monitor weight. This gives you a real-time weight of the bag at any time in the day. These alerts can be displayed via push notifications, SMS or pushed straight to the bag digital interface [6]. This pro-active measure results in students and parents

avoiding less necessary items or shifting weight to other areas of the horse box so as not to overload it. Weight trends are available over time, and weight history can be logged. Parents, school administrators and healthcare providers can then use this information to determine if a student may have excessive weight gain so they might know when action should be taken. This data analyzed on regular basis can help in understanding that when the bag is getting loaded everyday compulsorily, which may point an indication of taking proper timely measures at very nascent stage to avoid long-run health related issues. The weight measurement is important for avoiding musculoskeletal issues and back problems due to versatile scholastic loads.

C. Timetable Display

Enhance the organization and academic readiness by introducing a digital timetable display in smart school bag. The digital school bag will feature a display screen that students can read their daily schedule. This display will find a place on an exterior of the bag, so you can check this screen without opening the travel gadget. It is connected to the bag via APP and a school timetable online scheduling system with the screen of information on both sides; all changes will be updated automatically from schedule towards bag-information display. The display will show the current class and next few periods to remind students how much time they have left. Additionally, it will send reminders for assignments or exams just everything important. The system can also generate reminders of the materials needed for each class. Thus, if a class requires a book in a one-time class, the system can alert the student to pack the said book. The common forgetfulness of required materials and a high level of Procrastination among the students leads to poor preparation for classes and, consequently, poor performance in their academic work. A timetable display would help instill proper organizational skills in the learners, ensuring that they are always on time and well prepared for their classes.

D. RFID Technology

The RFID (Radio Frequency Identification) technology is used with books. This device is in the smart school bag. RFID chips can be attached to each object a student has: books, notebooks, any supplies etc. The second is the application where tags are

attached to all useful items in school and clothing logistic chain this RFID reader is integrated into a smart school bag. A mobile app allows the digital inventory to be accessed and viewed on a smart phone or displayed on the bag's digital screen [7]. The RFID system automatically adjusts the inventory as articles are added and removed. With this feature, students always know what they have in their bag and never lose anything. For instance, if a student has forgotten to pack an object they need for class or camp that day, the service will alert them directly and possibly even send notifications home. This would be great for immediately in the morning before school to correct something if it gets left out. Alerts can also be timed, so that students have the proper items needed for each class during their day. RFID technology also acts as a theft prevention tool. The system can alert store associates if an item is being taken out of a bag without permission, which could reduce theft and prevent losses [8]. For example, should an item go missing the RFID tag will be detected allowing management to know the last known place it was scanned enabling them to locate that particular part rapidly.

E. Battery and Power Management

Supply the power to all smart devices of smart School Bag on round clock basis and better UX using effective battery management & charging system. The bag itself is powered by a built-in rechargeable battery that controls all the electronic functions integrated into it including GPS and weight sensors, RFID system as well as references to previous use based on whom was carrying them. Without a properly functioning battery, all the features will cease to work properly through query. This battery capacity will be designed to deliver a full school day of typical usage. The battery chemistry could be lithium-ion or other high-capacity type commonly used in portable electronics, depending on the power requirements of the components [9-10]. The solution will implement clever charging management system. On a long school day, or during outdoor recreation. The solar system will kick in alongside the main battery, acting as a secondary power source to help reduce reliance on electrical charging. The smart school bag needed to ensure effective battery and power management, so all features are always fully operational during the entire school day. Efficient power solutions such as solar charging have been integrated in the smart bags hence

making it easier and more convenient to use with fewer disruptions due to battery issues.

F. Microcontroller

As a central processing unit that will manage the operation and synchronization of all part in smart school bag. The microcontroller is the heart of our smart school bag, it receives data from all sensors and a module sends preprogrammed instruction to every other device and manages responses. It is responsible for handling the flow of data among various components and ensuring that everything runs in a streamlined manner. We select a microcontroller that is capable of handling many kinds' inputs and outputs, low power consumption, fast enough to do real-time tasks efficiently. The data from various sensors (like weight sensors, GPS module, and RFID system) is collected by the microcontroller. It will analyse this data with predefined algorithms and conditions to take the required actions which may be like broadcasting an alert or anything. Firmware for smart school bag features to be run on the microcontroller [11-12]. The firmware of the bag can also be remote updated through the mobile app, so there will not always need a physical person for updating it. The smart school bag is always to be kept updated so that the latest technologies are implemented and students, as well their parent's needs, are met. The microcontroller plays an important role in guaranteeing that every smart school bag functions smoothly. Because it manages all facets, the bag can function as a system and seamlessly store or index data providing consistent performance [13].

G. Notification System

In order to send notification on timely manner regarding their smart school bag status of the parents and student for a safe, organized & better end user experience. It sends out notifications whenever the bag is beyond a healthy weight limit. This type of alert advises the user to offload or reposition any items that should not still be in there which could help avoid various health problems arising from such practices, as well back and shoulder strain. The notification will provide the weight at which the bag is running now and advice on what would be ideal based on kid's age, health and other relevant aspects. Parents receive real-time location alerts to track their child. These alerts are used to fire either at set times or else when the child

passes certain locations. Within the mobile app, parents and students can select notification options like desired types of alerts and how they want Location updates to trigger notifications can be set for specific times such as school arrival or departure versus an “always” alert. Emergency and critical alerts are sent immediately, but the system can be configured to renew sending or make an alert more urgent if the standard way failed. An advanced notification system improves the usability of smart school bags, and provides information on things such as safety level (opened or closed), organization reminders to help student be organized in their upcoming day at schools, battery status etc. Personalized alerts mean the system is not seen as annoying it knows more than me, after-all! This feature makes parenting a little easier and helps the student to keep on top of their school life.

H. Mobile App Interface

Creating a mobile application interface for usage by parents and students to easily interact with the Smart School Bag, receive notifications as well manage all functionalities such as alerts on weight limit exceeded or location tracking. Specially designed Mobile App with a very straightforward interface so students and parents will find it really hassle free to operate school bag smartly. The app will offer a dashboard with live info about where your bag is, whether it's been opened (yes!), tracked weight and content inventory. Bag data can be tapped into in real-time, with alerts and notifications pushed to the user's Smartphone or tablet. The interface will be created to accommodate various types of users, so that both students and parents are able to use the app. In addition to notifying the parent when their child has arrived at school using GPS, this mobile app also displays current battery levels of smart schoolbags and alerts if they need charging. It can even display how charged the bag is when you are charging it. The app allows users to modify power management settings which help them extend battery life either by disabling features that draw lot of juice from the device, or enable some sort of a power-saving mode. A well-designed mobile app interface is crucial to making the smart school bag user-friendly and completely meshed into students' daily lives. As you can see, all these features of the bag are managed in one central repository providing convenience, increased security and flexibility over a wide range of functionality that caters to your individual needs.

III. ADVANTAGES AND DISADVANTAGES

The advantages and disadvantages of smart school bag system using IOT are discussed with different aspects.

Advantages of the Smart School Bag System

1. Enhanced Safety:

The GPS tracking feature ensures that parents can monitor their child's location in real-time, providing peace of mind and quick responses in emergencies.

2. Health Benefits:

The weight measurement function helps students avoid carrying excessively heavy bags, reducing the risk of back pain and other related health issues.

3. Improved Organization:

With timetable displays and reminders, students can manage their schedules more effectively, reducing the chances of forgetting important tasks or materials.

4. Parental Involvement:

The system allows parents to be more engaged in their child's education by monitoring bag contents and ensuring that students are carrying the necessary items for school.

5. Time Management:

The integration of timetable displays encourages students to manage their time better; promoting discipline and helping them develop essential life skills.

6. Data Insights:

Schools and parents can gain valuable insights from usage data, helping to tailor educational resources and support to individual student needs.

Disadvantages of the Smart School Bag System

1. Cost:

The advanced technology integrated into smart school bags can make them significantly more expensive than regular bags, making it less accessible for some families.

2. Privacy Concerns:

The use of GPS tracking and data collection could raise privacy issues, with parents and students potentially uncomfortable with the level of monitoring.

3. Dependence on Technology:

Over-reliance on the system might hinder the development of self-management skills, as students could become too dependent on automated reminders and tracking.

4. Technical Issues:

Like any technology, smart school bags could face glitches, battery life limitations, or software malfunctions, leading to potential inconveniences.

5. Durability:

Incorporating technology into a school bag could affect its durability, especially with exposure to daily wear and tear, potentially leading to higher maintenance or replacement costs.

6. Digital Divide:

In regions where access to technology is limited, the implementation of such a system could widen the gap between students who can afford smart school bags and those who cannot, potentially leading to inequality in educational opportunities.

IV. CONCLUSION

Sitting at the cross-over between education and technology, smart school bag system offers transformative virtues. When a student is out with Scala, parents can look to the GPS tracking and have peace of mind about their whereabouts. With this magic device you can weigh all children and not allow them to carry heavy loads so that their health is good, too. With timetable representations, it is a lot easier for schedules and assignments to be organized in an appropriate manner that will allow students to have better control of their timings. Also, more interactive way of learning could be facilitated through interoperability with other educational tools and systems. Using data analytics, the smart school bag can diagnose usage patterns and tell how and when students use them to educators or parents in need of assistance on making decisions about student necessities as well as resources. From a practical perspective, therefore, the smart school bag system helps to solve real-world problems while nurturing interpersonal skills and creating a healthier more organized educational ecosystem that maximizes efficiency. As the technology develops, it is poised to

reinvent how students learn from their school materials and navigate through the education process.

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