INTERNET OF THINGS (IOT) BASED EDUCATIONAL DATA MINING (EDM) SYSTEM

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Abstract

Internet of Things (IoT) is an emerging trend in the field of technology, which has derived a lot of attention in the recent years. The ability of this technology for reducing the burden and strain on the education or academic system makes it possible for deriving a potential and raising the standards of academics. This study proposes a standard model for the educational system with the help of IoT. This paper gives an IoT based modal for the student engagement till the industry institute linkage plan. It gives a design in which the monitoring of RFID based data can be done and results could be discovered using the IoT techniques for the further selection criteria of industries. The results for any student shall be updated and made available based on the student data and business intelligence can be applied to the university system for giving the industry for best students. The study tries to relate various components which are later for the model generation, including the strength, weaknesses, opportunities and threats for a wearable IoT university system. A lot of challenges are based by the field of academics and University’s as far as security and privacy is concerned. Future direction in the research can be derived from the existing proposed model in the study.

Keywords: IoT, e-learning, computational learning, System Adaption, Security, privacy, challenges, smart devices, sensors-based devices.
I. Introduction

The academics domain which includes a large amount of data from the university and educational organizations are very important. The integrity of data lies in the fact that the student’s information can be made use for high importance. Apart from the student engagement in the class sessions the analysis of Big Data collected for the evaluation can be of prior importance for the organization that can recruit a graduate from the university. The use of Internet of Things (IoT) can be a very versatile technology to provide a specific and strong ground for the assessment and management of data. The RFID is a popular approach for student engagement management. The information from the student evaluation is obtained from e-Learning based system and adaptive learning. The coagulation of the two results can simultaneously yield a collective modal for the system in which the system can be used for the proper assessment as well as the industry institute linkage program for the complete years of learning. The industries also prefer to have students that have a bright background during the academic learning years. All the stated facts lead to a collective design and modal for the learning industry. This modal proposed in the paper uses the IoT schema to yield great results for the benefit of university students as well as the industry.

It can be well identified that the teaching and learning process in the whole academic environment is making use of various large datasets. Deriving it further to a next level, we can predict the use of data mining techniques to yield results. Strategic decision-making by the management and higher officials can be done with the help of these datasets, depending on the nature of the information. The behavior of the student and the teaching methodologies can be improved with the help of such model. The accessibility of the model in various locations like library, attendance, or any resource of the University requires a system for teachers as well as students [V]. In general, the availability of such a model, which is capable enough for monitoring and observing all the activities involved for the teaching and learning procedure is required. The model should be self-sufficient, which provides the characteristic of data mining techniques as well as deriving results with the help of deep learning parameter. Data analytics. In accordance with artificial intelligence will provide a very healthy and strong platform for the study of all the students inside as well as outside the model. The learning trend of the student can be predicted with the help of such a system. There can be various other derivations that can be done with the help of an IOT based system. The use of RFID circuit’s and wireless sensor networks had contributed to an enormous change in the field of IOT based services. The emergence of technologies like cloud computing and big data analytics are a further add-on to the power of Internet of things. The integrated potential of both the two technologies makes it possible to generate models which are capable enough for making proper analysis of any system. The learning behavior of the student can be identified with the help of the RFID circuits and the power of data analytics. A combination of both the two techniques will be a great change in the field of teaching and learning. Students’ learning behavior can be well identified and predicted with the help of new technology driven model [V].
Three stakeholders of the model are university, industry and society. The interconnection and correlativity between the three entities is a requirement of the study. The main emphasis is done based on two important factors. Pure research knowledge and protection of commercial rights should be taken into deep consideration for the emerging innovation [XII]. With the help of the upcoming technologies, such as WEP2.0, Django, HTML5.0 etc. it becomes really possible for various cross entities to interact on the same platform and generate results. However, with the growth of cross-platform bulk amount of data is generated and crowded in a distributed fashion. This data can be utilized for performing various researches and experiments in order to find out the best productive innovation [XII]. Since the past decade, a significant change has been observed into the paradigms shift of working model for solving various real-world problems. The shift in the technical part refers to the use of various new technologies which are IOT enabled such as wireless sensor networks, cloud computing and big data analytics [XVIII]. Critical information can be carried out, and it can be analyzed with the help of sophisticated mechanisms for learning behavior of students. Various institutions are making use of such tactics, to analyses and minimize the approach of educational data adaption.

The management of such data can be used for obtaining various strategic decisions of the Institute and the organization completely. During the learning mechanism in phases, the student is in touch with his, teachers the most and hence the model proposed in the paper also provides more appropriate learning strategies and intervention programs, which could be helpful for the teacher’s perspective in order to connect student relevant information for the industry Institute program linkage. The core idea produced in this paper depends on two main factors, collection of strategic information and applying Internet of things strategies on that piece of information of the students and providing large enterprises and industries actual piece of information and evaluation of the students that are required at any instance by the enterprises. The digital transformation in the sector of education and learning had facilitated the outcome of a proper system that is based upon statistics covered by the application of IoT enabled technologies for the University.

II. Related Works and Background

II.i. Student Attendance

The curriculum and the design which is created by the University is, a complete set of modules which contains all the subjects that are required for the overall growth of a professional after he completes his studies. This structure of studies contains credit hours for every subject, and courses that are offered by the University under the teaching paradigms of computer science. The attendance of students. However, is the most important part for the entire program, and the availability of student makes it effective and complete? If the student attends the entire curriculum as directed by the credit hours, he subjected to attain a higher level of knowledge and contains the necessary skill sets which are required by the enterprise and industry level professionals nowadays. A new factor that can be observed into the latest type of engagement activities is the geographical engagement of the student. It is observed in certain studies that the geographical engagement
makes it possible for the learning of a student to be more particular and perfect in nature [XIV]. It becomes the duty for the academic instructors as well as teachers to enroll the student in tone activities which are very helpful for the improvement of the student including the behavioral aspect. This will be really helpful for the prediction of the future performance of the individual at industry as well as social level [IV].

II.ii. Radio Frequency Identification

Radio Frequency Identification, which is commonly known as RFID, is a wireless communication system which is bidirectional in nature and makes use of electromagnetic fields in order to provide identification and tracking the objects and things [XXV]. A basic system of an RFID comprises of two important parts. The first basic part is the reading or writing tag, which is capable for observing information from any electronic device can reaching the scanner. The RFID scanner is operated with certain frequencies and an antenna, which is capable for accepting signals coming from any other electronic device compatible with the RFID signal transceiver. The coupling part of the RFID scanner is the electric circuit which is sending some signals from the user end. The RFID tag, which is available on the user side contains electronic information which can be used for sending or receiving signals. Any RFID tag have an electronic information called the Electronic Product Code (EPC), which is a 96-bit identifier of up to 2 KB data and can be read from a given frequency range[X]. Unlike barcode technology, RFID can be operated without any direct line of sight and action. The transceiver and the emitter are capable enough for operating without any physical connection line of sight action. Thus, it can be one of the best techniques that can be used for the tracking of the information of the students in the University. The scanner which is acting as a trans-receiver, can be installed at the premises having an antenna to accept the signals that are coming from the RFID-based cards of the students.

All the RFID tags that are connected to a particular circuit contains their own source of power and battery. The power sources are actually responsible for increasing the range for the transmission [X]. Thus, it is necessary for the tags to have their own power. They emit a signal in order to transmit the stored data in the chip. The tag will be containing information in the form of digital data that can be transferred over wireless medium. The RFID tag, composes of two different types: transponder and beacon. The transponder gets activated whenever it receives a particular signal from a reader circuit. Whenever a signal is received, the battery activates and the dressed processing takes place. On the other hand, a beacon, is designed in such a way such that it will be able to activate itself when using with the real-time location system. The working of a beacon is activated whenever a particular set interval is achieved. At a particular timeslot signals are sent and the tag information along with the position is transmitted from this device. Thus, the information can be tracked with the geographical input parameters. The information can be tracked from the geographical latitude and longitude positional system which is synchronized with the RFID installation system at the beginning.
II.iii. Data Analytics and IoT

Many of the educational systems and units and started making use of the educational data mining systems. These systems are sufficient enough for the institutes to measure and analyses the complete report of the learners and their needs, including the engagement and behavior. The success rate and the retention rate of the students can be well determined with the help of such systems. This data analytics on basis of educational information had emerged as a very bright field of research and teaching. The assessment in the education is not only subjected and related to paper and pencil examinations, whereas, the use of sophisticated data mining system had made it possible to obtain fascinating results, which is available from the analysis of the student’s information and the results in various disciplines. According to [XXIX], the main strength of the analytics process can be identified and achieved with the help of analyzing “monitoring, prediction, intervention, assessment, analysis, personalization, recommendation, and reflection.” With the help of visualization and various techniques of analyzing the data, various learners are now able to understand and improve in their learning experiences and performances. It is also made easy for the teaching methodology and academic management to satisfy and analyses various important aspects that are required for the learners to facilitate them with modern and fast learning techniques. The allocation of the resources which are required and the services which are available in a timely and efficient manner can be done with the help of such analysis [XXXIX].

The data mining and analysis of the student information can be done over various procedural aspects. At the beginning there is a need to identify various datasets that will be under consideration for the analysis and mining that includes the learner’s role and the learning environment which is responsible for the retrieval of data from the information system [XXXIX]. In the second step the data has to be clean and transformed into suitable formats which is required to be analyzed by the analysis engine. This step can be considered as a pre-processing step in the field of educational data mining system[XXXII]. The data obtained from this step can act as a raw material for the next step in which proper statistical and data mining techniques can be applied with the help of trends and patterns in order to obtain the predictive outcomes. Various common algorithms and techniques can be applied in the data mining that includes classification, clustering, regression analysis, artificial intelligence-based systems, genetic algorithms, and neural networks [XXXI]. Finally, the result of these complete analysis can be given to the enterprises and the industries that suits the complete requirement of the system-based learners. Depending on the requirement of the industry and the enterprise which is taken into consideration, various data mining techniques can be done on the dataset that have been collected from these systems and can provide a very good source of information required in the near future for the enterprise. The selection of right candidate for these enterprises can be done with the help of such a data mining analysis system.

III. RFID Data Collection Model

There can be various innovative techniques and practices that are involved in finding out attendance of the system at any level. The traditional attendance
management system contains management of a register that is handled with the help of a teacher, and consequently, every teacher maintains one register for the students. However, this approach is not at all acceptable now because it is difficult to compile so many attendances for the student from the various teachers and obtain a genetic report. They are time-consuming approach which requires more of efforts. The second system can be at attendance taken with the help of web-based attendance systems. These systems are effective, but, they also require a large number of efforts and the maintenance of reports at the end of the semester or the year. However, the use of these reports is not done, and not techniques of data mining are applied on these reports.

![Industry Institute Requirement Venn diagram](image)

**Fig. 1:** Industry Institute Requirement Venn diagram

### III.i. RFID Applications

The vulnerability of intrusion detection or increased workload of the teacher or administrator can be obtained by both the two approaches discussed above. However, the use of RFID applications are beyond real-time monitoring and tracking. Historical data and its analysis can be done on the go with the help of various data mining techniques on RFID-based application data [XXVI].

### III.ii. Attendance System

The most common use of RFID-based systems is systematizing and facilitate various processes that require manual labor. These processes results in transparency and very fast report generation which are required for teachers and management to a wide workload and increase efficiency by delivering various services, as it is required. Various studies have supported the fact that the use of attendance management and the engagement of students into various activities is a strong pillar, which is responsible for the growth of academic success [XIII, XV, and VII]. Thus, poor student attendance and engagement would likely lead to poor academic results. It can be derived that the student attendance is of prior importance for any organization or it could make institution. The more time student dedicates further studies in the University, the better are the results for the knowledge level of the student as a whole. Directly or indirectly the entire evaluation of academic institution depends on the final results of the Institute, students and their final placements. There are various systems which involves taking the attendance with the help of RFID circuits that are proving very powerful for monitoring the activities of the student.
The overall performance and progress of the student depends on the activities that can be identified with the proper identification of their availability at a particular place. This type of methodology can be very helpful and efficient to reduce the time taken and the consumption of manual efforts which are done in various systems [XXXIV, XVI]. Also with the help of these automated systems the school management can now track and locate the students’ whereabouts in combination with barcode, biometrics and GSM technologies [VI, XXX]. Some studies have presented technology models that may predict student outcomes based on attendance. These models do some kind of data mining techniques that can give a comparative study of the attendance of the student and predict the results of the final evaluation process. They can as well as predict future attendance of students [XXXIII]. However, as understood from various systems making use of such policies are isolated in their nature. The isolated systems becomes a big problem when data analysis and data mining is required. Unfortunately, most of these analytic systems are isolated systems. Because of such a reason, a technology which is compatible with the RFID model proposed is expected to evolve to overcome the anomaly of the existing system. With the help of such techniques we can find out the entire analyses.

III.iii. Library System

There are a number of systems which makes use of RFID for managing the library. The management of library refers to the searching of the books, issue a book to a user, returned back a book and self-help over any inventory in the library [XXI]. Some of the systems which makes use of such technology can be integrated with the help of mobile phone that are capable for RFID interactions and can act as readers [II]. The participation of a student in the library and its utilization can result in a far better analysis of educational data mining and application of Internet of things on the datasets obtained. Various library administration manager is find it difficult to maintain the records of the attendances of the student in the library. Whenever such processes to be used the students are required to enter all their attendance with the help of a paper-based register system. There are various libraries which are not making use of such a technique. So it is difficult for library staff to monitor library usage. An RFID system can answer this issue. The availability of RFID-based scanners can automate the process of attendance, capturing and evaluation. The data generated by this system can serve as an input to measure student engagement.

III.iv. Learning Management System

There is a widespread use of RFID system for access control. When use in combination with computer science methods such as face recognition, it will result in a more secured access control system [XXXVII, XXXVI]. As a computer science and information technology facilitated audience, the amalgamation of various access control mechanisms along with RFID-based scanners can be very helpful to facilitate the utilization of various systems like e-learning or laboratory facilities for the students. The use of RFID scanners can be done in order to obtain the authentication of verified users for any particular system. Only those students are learners which have a proper RFID will be allowed to use various automated systems at the University level. The data obtained from such systems can be used to analyses the
learning capability and potential of the student. This data can be then forwarded to any enterprise industry which targets a particular level of students. So, it is a win-win situation for the industry as well as for the learner.

III.v. RFID Challenges

As there are two faces of a coin, several significant problems are also associated with the RFID standards which include the management of the data and the issue of deployment for the service. However, it is not at all necessary to discuss on data management - volume, veracity, velocity and variety [XI]. Just for example, to provide timely and effective. It is necessary situation that the assessment of the engagement for a particular student at academic institutions should be done every day. The potential for generation of large database sets in this process is expected. The availability of such big datasets and then transforming the information which is collected by them into meaningful data is required [III]. This holds great risk of system failures. Special care has to be taken in these regards. The issue of data reliability. An inconsistency can appear in the system due to low-level RFID data which can be missed or redundant in nature [XXVIII]. Several researches have given various techniques for the rectification of various problems this are associated with the filtration techniques. Some of the well-known data correction algorithms that are proposed by the studies from Jeffery [XXVIII] and Darcy [XXIV]. Also, an RFID-based architecture also presents deployment challenges. One more big issue, which comes into the picture is the ownership of the data which is accessed from the datasets. Various academic organizations and universities are challenged to have positively address the issue on privacy and security [XXXV]. But as compared to the problems that are available in the RFID-based systems, the points in favor are more and thus by taking special care and analyzing the data properly by the IFC techniques and educational data mining. Proper results can be obtained for various enterprises and industries with the help of proper techniques of educational data mining using RFID systems.

IV. IOT Based RFID data – Educational Data Mining

Today, the need for the hour is processed information for any student as per the industry norms and levels. In a lot of emphasis is done by the universities in order to collect the information, but there is no emphasis is done on the dressing up of the mission from raw to meaningful. The industries demand that the labor that is supplied from the universities to the enterprise must be reaching the level of the enterprise. If after applying some heuristics on the databases obtain from the University, one can try to find out the best match as per the industry norms and standards.
The process, which is adapted in the model is collecting the data from all the sections of the universities that are discussed in Section III. This information is however not sufficient to be utilized for enterprise level. Thus, the information that is collected from these IOT enabled systems, is then passed on in order to apply some system dynamics an IOT based data mining educational data. The IOT based educational mining intern tried to retrieve the results that is required for the enterprise, depending on various facts and features. These facts are in accordance with the industry standards that is required at the need of the hour. The heuristics that are used to calculate this meaningful information will vary from the need of the enterprises. The factors that will be responsible for the shortening of the data will be handled by the industry Institute linkage model. Based on these factors the final selection of the candidates can be done on a minor and major scale. Such a system is designed in order to provide the proper raw material which is required by the industry that turns up to a finished product from the University. Such a system will be of immense importance that will save a lot amount of time and caliber for the intermediate entities. This will try to produce results, which is required by the University and the enterprise.

A large number of entities are involved in this program, which contains elements from the University and the students. The modules of library and examination, along with the attendance model for the students in the University comprises of the prime and raw input for the RFID based education data mining model. The role of the enterprises is equally important in this regard. The quality parameters required by the industry are matched with the parameters that are involved from the RFID based education data mining system. All the factors that are common in both the regimes are further taken care with the help of a final realistic which will match the details and produce the results that are desired by both the parties.
Fig. 3: ER Diagram for the System

This can be a very good win-win situation for both the stakeholders. However, it is not a simple job to handle such large datasets. And it is also very difficult task to write the heuristic program for both of them.

V. Results

As it is observed that a large number of enterprises are in need for labor and employees which are of the level of the organization. All the students in the University are not equal in their level of thinking and hard work. The core idea of the system is to provide a working model which is capable enough, to analyze the RFID based attendance is of the students. Various modules at the University level comprises of attendance management system, but they are not sufficient enough to detect a result. The punctuality of a student, the potential of working, ability of solving the problem etc. can be calculated with the help of the heuristics that can be applied on the information that is collected from the RFID scanners. These RFID scanners are capable enough to produce data without manual monitoring or administration. Whenever a student enters a particular place in the university, his information recorded by the RFID and then passed on to the heuristics of the system. These systems are capable of generating a particular report about the student including some fuzzy logic-based parameters and capability set. The result, which is opted from all these heuristics for all the years of the study of the student can be stored in a database that can be obtained after the successive education data mining. Finally, from the enterprise point of view, the dataset, which is required of the students shall be made available from the EDM system. The criteria of the enterprises are matched with those that are available from the educational data mining node and finally the classification of the students based on the industry demand can be done.

This system can be of immense importance for various factors. These factors can be classified on the basis of various categories. Proper monitoring of the students: RFID-based systems are capable enough for monitoring the attendance of the students at any instance whenever an RFID receiver circuit is active. This system ensures that the
availability of any student in the University premises recorded and ready to be used for the further heuristics. Requirement analysis of the enterprise: the need of the industry nowadays is not very simple and the use of various heuristics to obtain the requirement from the industry point of view is very important. This can be done with the system very easy and effective. Reduction in the cost required for the trainings and selection procedure: a large amount of cost is involved in the training and selection procedure adopted by the enterprises for the recruitment of new Labor in their organizations. The system will try to reduce this cost which is dependent on outsourcing and hiring consultants to provide manual labor.

Machine-based matching criteria is depending on the heuristics: since the heuristics are machine-based and the matching criteria for the same also depends on the processing speed of the machine, it becomes properly very simple for the job to be done in time. This will bridge the gap between the industry and the Institute in order to produce goods and final products in the form of the required man force. The standard of the industry has to be matched the level of the University teaching. Does the curriculum of the University will be so designed that it will match the criteria is of the enterprises. Reduction in the cost for human resource management system by the industries: the entire cost which is involved in the procedure of human resource management at an enterprise will be reduced by a very high factor that varies from industry to industry.

VI. Conclusion

So, it would be concluded that the system that is depicted in the paper is of immense importance for the universities of Saudi Arabia, which will always provide better results for all the students as well as the enterprises. It could also be notified from the system, which a big range of various tasks and activities are to be recorded for the student which helps in the monitoring and observation of the student as an individual. This will help in creating desirable human resources that are required by the industries. Finally, the system is making use of heuristics that are using Internet of things-based criteria is that are very effective and are used nowadays in practically every field of computations. Finally, as a future work, the system is expected to grow on a very large-scale platform that will be using the students from all parts of the university and evaluating them on a common platform as per the requirement of the industries and enterprises. The use of more powerful and fuzzy logic-based heuristic methods will be provoked and inculcated in the desired system of evaluation.

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