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Towards A New Approach Using RFID in High Schools and Universities

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Abstract*: *Everyday objects are generating a large amount of data that should be stored in the memories of their chips and communicated to a reader. One of the most important technologies used in the Internet of Things is RFID. Radio Frequency Identification RFID is increasingly used in various applications because of their high quality as well as their low costs. In this sense several applications have been proposed in the literature in the domain of school management that have increased the efficiency and effectiveness of the education in schools into which it was integrated. In this paper we propose an application of Internet of Things based on RFID tags to take the reporting of student's inscription and career within a high school or a university in order to generate a predictive classifier to extract high level meaningful information that can be used in making decision in real time for short and long term. These decisions are related to the integration rate in the world of work by graduates; the need of the employment market in terms of training and formation. Furthermore, the generated reports would be useful to figure out the anomalies that usually lower the overall integrity of the school system.
Keywords*: *RFID; Management; schools; tags identification, datamining.

I. INTRODUCTION

RFID Radio frequency identification is a technology used to identify an object, follow its path and know its characteristics remotely using a label (RFID tag) attached or incorporated in the object [1].

Radio Frequency Identification RFID is also a technology used to store and retrieve data remotely using tags; the "RFID Tag". These tags, are composed of an antenna and an electronic microchip, they are able to respond to radio waves and transmit information remotely. There are three types of RFID tags; actives, passives and semi-passives. The main difference between active and passive tags is that active tags are equipped with a battery for power supply, thus it have a shorter life cycle, while passive tags are recharged from the energy of the reader once this latter is activated and thus it have a longer life cycle. Table I shows other differences between the two types.

TABLE I
RFID TYPES [2]

Passive (Without battery)	DataStorage (Programming)
Smaller, Lighter Shorter range (<3m) Smaller data storage Lower cost	Read Only Write Once Read/Write
Active (With battery)	Frequencies
Larger, Heavier Longer range (>100m) Larger data storage Higher cost	LF : 125,135 kHz HF : 13.5 MHz UHF : 860-960 MHz Microwave : 2.4, 5.8 GHz

A. RFID tags come to replace barcodes, and have several advantages compared to these latters [3]

1) RFID tags can be read from a greater distance than barcodes.
2) RFID tags don't need to be positioned in a line of sight with the scanner.
3) RFID tags can be read at a faster rate than barcodes.
4) RFID tags are read/write devices.
5) RFID tags carry large data capabilities.

However, RFID present a big issue compared to barcodes; the problem of tags collision in RFID systems. This problem was the

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subject of several works proposing anti-collision algorithms and mechanisms like in [4], [5], [6]…. Otherwise, during these last years RFID was widely used in several fields and applications such as smart grid [7], [8], health [9] and so on.

this research, we propose an application based on RFID technology, the application consists of using the information captured from student's tags within a high school or a university to make decision for long term related to the integration of the world of work by graduates and the need of the employment market in terms of training and formation. This information can also resolve problems such as multi inscription of students in many schools and saturation of job market. Furthermore, this system will not only provide school managers with meaningful information not available from traditional manual system , but it will also be able to forecast the number of graduates each year looking to hang their first job thus allowing responsible to tailor their schedules and number of job opportunities accordingly. Finally, using tools of decision making, responsible of higher education can generate graphs, charts, and dataminig tools to incorporate an approach in the system architecture in order to figure out the anomalies that usually lower the overall integrity of the school system, to analyse the student overall career along the year and to apply that to a prediction model.

The remainder of this paper is structured as follows: in Section 2, we will present two applications of absence management within schools based on RFID as related works. Then in Section 3, we will introduce the proposed application, we will discuss its different aspects, then we will conclude this paper by summarizing the contents and suggesting future work in section 4.

II. RELATED WORKS

In the literature, there are many applications proposed in order to track in different fields using Radio Frequency Identification technology such as applications to track the attendance of people in an enclosed environment which include hardware integrations in Schools [10], fish tracking [11] Asset Tracking [12], bus tours [13] and school bus tracking [14]. In this section we will present two applications for student's attendance management in schools based on RFID..

A. RFID Absence Management application

The principle of this application is how to utilize the captured data to accurately predict the current or future presence of students. Indeed, in schools, knowing the amount of students attending a class, give the ability to predict an estimate attendance count which can greatly benefit the user [15].

Firstly, by using the RFID tags, students can scan their tags into the readers which are used by the lecturers. Secondly, the reader will transmit the information to the website used to record information as shown in figure 1. The website will then store the information in the centralized database which will then be accessed by the intelligent classifiers. Finally, using the Bayesian and Neural Networks, the lecturers can extract a feature set from the database including various pieces of information gained from the system and generate a predictive report based on the likelihood of the amount of people present in the future week's classes.

RFID tags are distributed to each individual student and RFID readers are implemented in every classroom in the school to capture absents. The student's tags will have a unique identification number that correspond to their respective name and university student number stored on a centralized database.

The RFID readers interact with the website to identify all tags and store the absence information in the data warehouse for further analytical processing.

The Feature Extraction is a function applied to the website to extract the captured information. This information will be used to determine the amount of student attendance in the coming week. This also includes the week number, the location of the class, the size of the class, the time of the class and the average time the student stays.

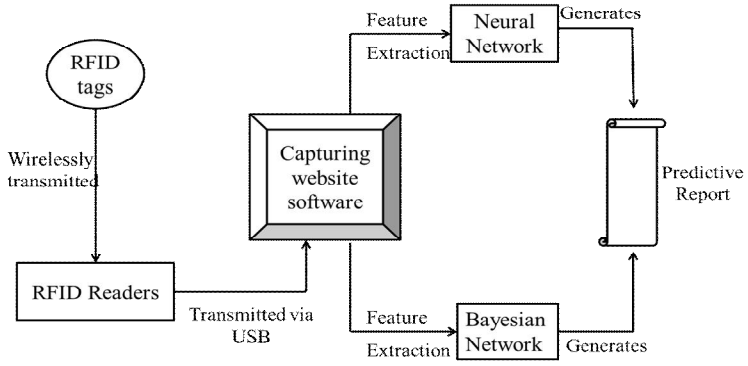

Fig. 1 A diagram of the data flow of the information in the absence management application

Once the feature extraction has been performed, all the extracted information will be passed directly into the Bayesian and Neural Networks. Furthermore, the system returns a set of information correspondent at each individual student. This information will be useful for the user in order to estimate the amount of students present in the class for that specific week and to incorporate historical information from other semesters. This will be also helpful to incorporate the student's individual attendance record to predict the trend of attendance for the entire semester rather than the sequentially following week.

As a result, the scanning process takes less time compared with the traditional roll call, approximately one minute to record 20 students, and gives more important results compared to the traditional roll call [15].

B. Smart Classroom Roll Caller System with IOT Architecture

The problem of student's absenteeism in schools and universities continues to be a great challenge for responsible and an important management goal of every level school systems.

Although tutors and teachers efforts to prevent the amount of student absence either using the traditional roll call, that would spend about 5 to 10 minutes and that is difficult for teachers to do it at every session, or using other methods of warning and punishments, the absenteeism rate of students is still high. This problem not only affects individual students but also can affect the learning environment of an entire school or university.

As a solution, the radio frequency identification (RFID) and internet of thing (IOT) technology are implemented at every classroom in the school to assure that every student lesson attendance record is collected by readers.

Many researches had been done in this field such as the RFID access control system which has been implemented in many applications [16], [17], [18], and [19].

In the following we will present the RFID Roll call system and the Smart Classroom Roll Caller System (SCRCS) and we will sum up with a comparison between them.

1) *RFID Roll call system:* The principle of this system consists of a passive RFID tags attached to student ID card holders and a set of readers implemented in the entrance of school [20]. Every morning each student uses his card to be read by the front side RFID reader installed near the entrance of school. However, all students would arrive at school at the same time in the morning and every one need to scan his student card, i.e; everyone must spend more than 5 min to 15 min to complete today attendance. In order to solve this problem, a solution using integration of the face recognition was proposed in [21]. Furthermore, the active RFID tag also was implemented as student card and setup the location system in the campus [22], but the active tags still rely on batteries and it have an expensive cost thus the use of this tags type is not trustworthy and can weigh the university as well as students budgets. Although these solutions were proposed, many problems persist such as the waste of student time, occupation of lesson time, problem of privacy which let some students not to hold their cards.
2) *Smart classroom roll call system:* This system has been proposed in order to overcome the limitations of the traditional roll call system and the RFID roll call system, i.e; to make roll call for every student's attendance easy. In general, the standard operation process of SCRCS is divided into three steps as follows:

a) Step1: at the beginning of their career in the school every student is provided with cards integrated with RFID tag and the school manager preload all card tag IDs into school's database. Then every student would use this card for all his years spent in the campus.

b) Step2: School installs one smart roll caller on each classroom and configures it with IP network. Then the server of computer center would receive the RFID smart roll caller information about student's attendance.

c) Step3: To be marked present, every student should bring his card when go to school and the SCRCS would scan these students' card to confirm every attendance. At the end, the amount of student absence will be stored at the school database in order to be transformed at meaningful information and used to generate predictive reports for decisive goal [20].

This research leads to solve the trouble problems of existing methods that are attendance impostor, occupation of lesson time and attendance record in real time.

The advantages of SCRCS are compared with traditional roll call and RFID roll call system in Table II.

Now, with RFID technology, the phenomenon of absenteeism in schools is more controlled, teachers in classroom in a high school or university can stop scanning rows of desks and making each student yell out "Here!" during a morning roll call.

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TABLE II
COMPARISON OF ROLL CALL SYSTEM [20]

Type	Roll Call System		
Characteristic	Traditional Teacher/ Checker	RFID Roll Call	Smart Classroom (SCRCS)
Check Method	Naming or list paper check	Passive/Active RFID Tag	Passive RFID Tag
Operation Time	Very long	Short	Shortest
Instantaneity	Impossible	Possible	Easy
Imposture	Easy	Easy	Impossible
Leave early	Easy	Easy	Impossible
Naming List	Printed paper or open electronic file	Printed paper or open electronic file	Visible ID cards on the wall
Security level	Low	High	High
Private Protect	Low	High	Most high
Supporting	None	PDA, Finger, Camera	IOT
Labor-saving	None	Ok	Best
Radiofrequency	None	HF, UHF	HF(13.56Mhz)

Finally, these applications help lecturers to monitor and control the rate of student absence in school, however, responsible in high schools and universities need to track student in the campus during their studies' years from different aspects. So, in order to assist responsible in their tracking process, this paper presents an application using RFID technology.
In the following section we will introduce the concept of our proposed application with a proposed architecture of different components of our approach. Then we will discuss some limitations behind the development of this application and some contributions of the proposed concept in the improvement of school system.

III. THE PROPOSED APPROACH

In high schools and universities, where a great number of students continue their studies, efficient smart system is necessary to monitor and control the progress of studies and the overall development of the school. This is can be achieved by using technologies of capturing information.
This application is based on RFID technology to collect information; it consists of operating and using the captured information to make it meaningful for analysis and future decision.

A. Principle

Tags integrated in student's smartphones will transmit a unique serial number via radio signal to an electronic reader, implemented in different area in the school; once the student enter the range interrogation of a reader, his identification is registrated. Indeed, keep the tag active all the time wouldn't be a problem for students since every student has a smartphone hold everywhere. Thus students won't have to stop, swipe their cards, press their fingers against a pad or interrupt their chatter with friends as they pile into school. The reader will instantly relay the signals from their tags to a school computer network and store all necessary information in the school database. On the other hand, instead of using Bluetooth or other technologies that necessitate energy and the smartphone to be online all the time, we propose using passives RFID tags to overcome all these requirements.
The diagram in figure 2 shows a proposed architecture for the management of educational system based on a transfer of data between the various components of the architecture. The information is collected by the RFID reader from RFID tags; they are then transferred and stored in a data warehouse, designed for the management of educational data, via a middleware.

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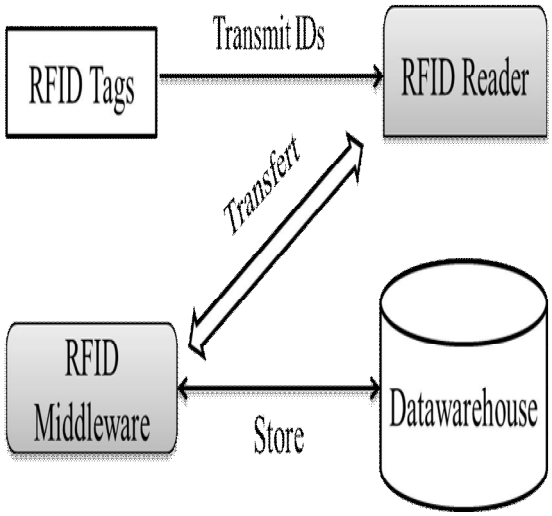

Fig. 2 Data transfer between the various components of the architecture

This is the new school manage rule to record every student's information, monitor and control who enters and leaves their building in real time as well as help tutors and teachers assist their learning state. This rule is also well for parents as much as if a parent wants to know any information about his child, he can contact the school and get directly all information required from the school database such as absenteeism rate, marks, child behaviour in the school and so on. Moreover, every student's information will be updated if any changes occur.

Furthermore, using tools of making decision applied to the high school data warehouse, school managers can generate graphs, charts and data mining tools to make statistical studies and predictive reports in real time at the benefit of the school. Therefore, these reports will be useful to figure out the anomalies that usually lower the overall integrity of the school system and to analyse the overall career's student year as well as to evaluate studies about the success rate, the integration rate of the world of work by graduates, the market need and also to predict the number of job opportunities to be created.

The architecture of the proposed application including the fundamental components is drawn in figure 3, and in figure 4 we provide a representative picture of reader's arrangement in a university entrance as considered in our application.

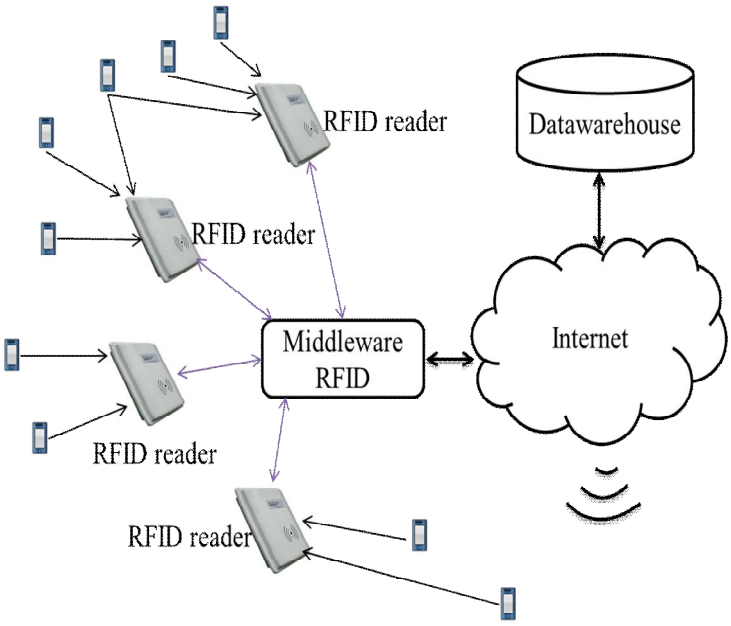

Fig. 3 The architecture of the proposed application

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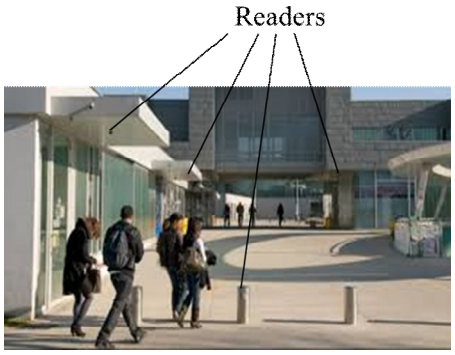

Fig. 4 Illustrative picture of reader's arrangement in a school entrance

B. Limitations

The motivation behind this research is finding an effective use of information captured from student cards in university classes. The question we need to consider now is how to help all students empower their learning by using internet of things and keep their tags always implemented in their smartphones? This issue could represent a limitation of the use of RFID tags in school since there are some parents who object that electronically tracking their children's whereabouts might compromise their privacy. But, when parents realize the effectiveness of this application in the learning career of their children and its contributions in long term they wouldn't oppose. On the other hand, in this application we don't have the problem that students ask their classmates to bring their student's card to prove their presence as in roll call systems but every student try to keep his own smartphone including tag because it contains confidential and personal information.

Furthermore, students in schools are obliged to hold their smartphones because without the identification, a student can't neither access the parking, the library and the cafeteria of the school, nor buy tickets to extracurricular activities. Consequently, all student's behavior and activities will be recorded in their file.

The challenges now is to make training in schools how to use this technology and creating RFID tags that student won't lose or destroy, a chip that can be easily integrated in their phones.

Finally, using RFID applications simply helps schools do more efficiently and effectively what they're already doing manually.

IV. CONCLUSION

The challenge in high schools and universities, where a great number of students continue their studies, is to monitor and control the progress of studies and the overall development of the school. This is can be achieved by using an efficient smart system to capture information and make meaningful prediction. In this paper we proposed a new methodology to capture information from student, via their student's phones implemented with a RFID chip; information is then transferred and stored in a data warehouse, designed for school management, via a middleware.

Using decision making tools, the data stored would be concretized into graphs, charts and reports. These reports will be useful to figure out the anomalies that usually lower the overall integrity of the school system and to analyze the student overall career along the year. Based on this reports, the school managers can evaluate studies about the success rate, the integration rate of the world of work by graduates, the market need and also can predict the number of job opportunities to be created.

No doubt this application would contribute at the development and the progress of high schools and universities. This is one successful tool to help students study well enough to compete after graduation.

V. ACKNOWLEDGMENT

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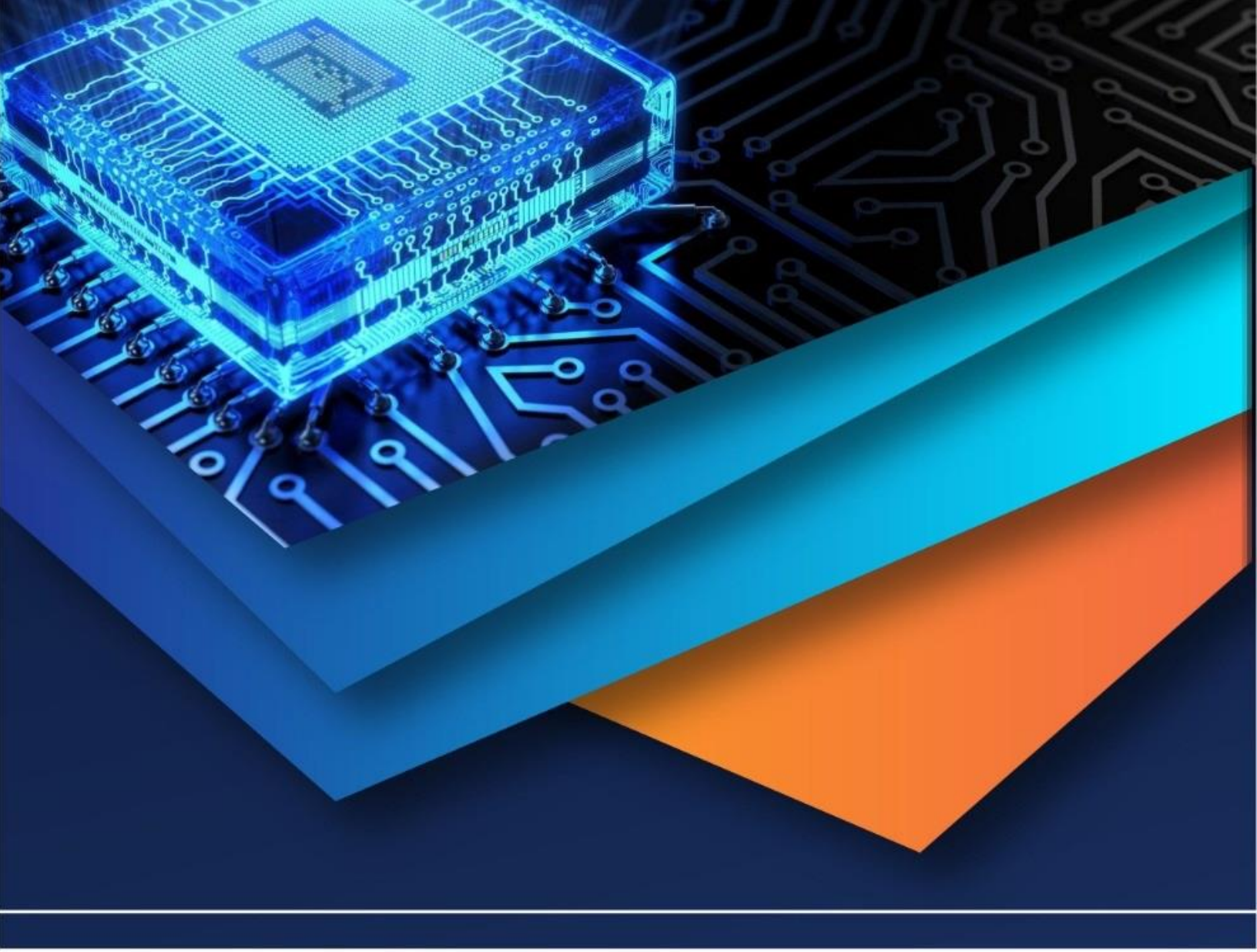

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