



The Internet of Things (IoT) and Space Allocation in Universities: A Case Study

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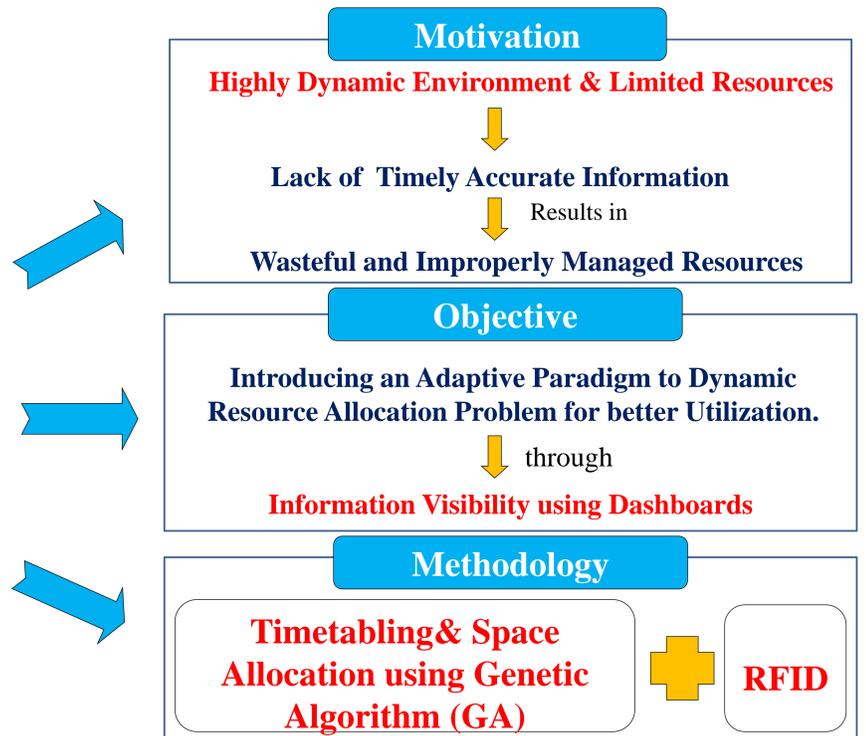
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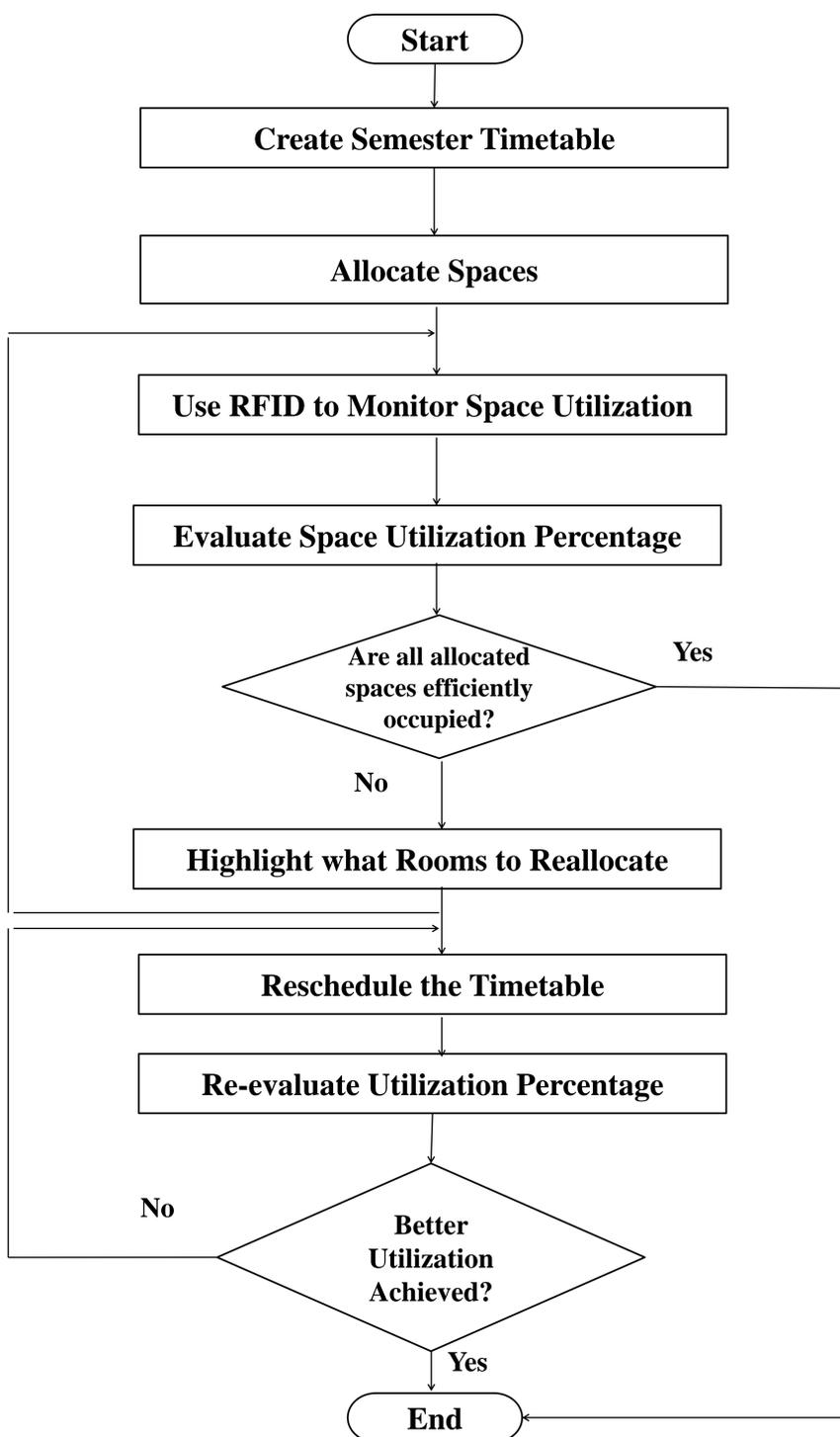
Introduction

Developing countries, with high population growth rates and limited resources, need to direct efforts towards making the best use of the resources available. Sometimes the problem is not because of resource insufficiency, but due to the lack of information about the availability of these resources. In Egypt, the higher education sector is represented by a large number of universities that should play an important role towards rationally managing resources. The dynamic nature and the different activities inside university campuses cause problems and inefficiencies in properly and dynamically utilizing and allocating spaces inside universities while guaranteeing the best allocation of these spaces.

Information availability and visibility of the allocation of spaces overtime may trigger reallocation decisions reflected in new timetables to be created. RFID as one of the Automatic Identification and Data Capture (AIDC) technologies enables traceability and instant data capturing to achieve improved business process and operational efficiency. This paper focuses on the space allocation and timetabling problems in universities using the RFID technology for better resource management. The paper also proposes a framework for the proposed approach and a review of the use of the RFID for resource management in higher education and the space allocation and timetabling problems. The paper introduces the results of the proposed methodology by taking the Faculty of Commerce, Alexandria University, Egypt as a case study.



Resource Monitoring Framework



Literature Review

A. RFID and Resources Management in Higher Education Sector:

RFID adoption directly contributes to managing and better utilizing a lot of institutional resources (Duroc and Kaddour, 2012). It keeps resources traceable and provides real-time information about every asset's location and condition. Thus reducing unutilized resources because they may be kept in places that are out of sight and that no one knows about. Furthermore, traceability increases security and saves a lot of time needed to monitor utilization (Polniak, 2007).

B. Space Allocation and Timetabling Problem :

Burke and Varley (1997) have made many efforts towards defining and discovering the different dimensions and requirements of the space allocation problem inside ninety six universities and academic institutions in the United Kingdom. They have discovered that efficient utilization of spaces inside academic institutions requires careful integration between timetabling and allocating spaces. Burke and Varley (1997) space allocation and timetabling in academic institutions are strongly correlated to one another. Reis and Oliveira (1998) stated that rooms and space allocation decisions are problems associated with the timetabling procedures taking place inside entities.

Methodology and Results

$$\text{Room Utilization Rate} = \text{Room Utilization Percentage} * \text{Seat Utilization Percentage}$$

$$\frac{\# \text{ of Hours this room is in use}}{\text{Total room hours for teaching}}$$

$$\frac{\# \text{ of occupied seats (using RFID)}}{\text{Total number of seats available}}$$

Description of the Actual Problem

No. of Courses	150	Good Utilization Rate	>=56%
No. of Rooms	32	Good Frequency Rate	>=75%
No. of Events	337	Good Occupancy Rate	>=75%
No. of hours scheduled/Day	12 hrs (8.00 AM-8.00 PM)		

	No. of rooms used out of 32	No. of rooms saved out of 32
Old Approach	26	6
New Approach	19	13
New App. + RFID	16	16

