# DRIVING THE SKILL ACQUISITION AUTO_TECH RESOURCE SHARING SYSTEM USING THE REALTIME WEB-BASED APPLICATION

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## ABSTRACT

This study designed a web-based real-time application to drive the previously designed Auto-Tech Resource Sharing System (ATTRESS) framework. It is designed to perform a triple function of coordination, allocation and information dissemination for a collision free allocation of the resources and time to all participating schools, for effective management of the resources in various zones. The modelling of the proposed system was achieved using Unified Modelling Language (UML) with mathematical functions. It was implemented using combination of PHP, HTML and CSS for the interface, Java Scripting language for application logic and MySQL as database. The proposed system was simulated and tested using sample data to ensure the efficient performance of the system modules. The test carried out confirmed the effectiveness of the designed system in achieving specified objective.

**KEYWORDS**: Realtime system; Auto_Tech System; Resource sharing; web_based system, Skill acquisition.

## INTRODUCTION

The study carried out by Omede and Okpeki (2019), revealed that the pretty efforts of the government at both federal and state level to produce young self-reliant school leavers by introducing skill acquisition subjects into secondary school curriculum failed to yield expected result. This was caused by unavailability of adequate infrastructures and man power for teaching and learning of these subjects due to poor funding and lack of maintenance culture for the few infrastructures available (Asiyai, 2012**).** As a solution to the problem; a framework of centralized Resource Sharing Centres for secondary schools in the three senatorial zones in Delta state, Nigeria was designed and recommendation made to the State Government to enable her provide all needed infrastructure and working tools for various skills at lower cost, thereby, giving all secondary schools in the State equal opportunity for practical-oriented education especially in the area of skill acquisition. The design presented a network of senatorial practical pools known as Auto-Tech Resource Sharing System (ATTRESS) for all skill acquisition subjects introduced into secondary school curriculums in the three senatorial zones in Delta State. The infrastructures, materials and human resources are to be shared among all the secondary schools in the state. For effective time management and seamless allocation of these resources, comes this complementary study on designing a real-time software for triple function of Coordination, Time Management and Resource allocation and Information Management of the ATTRESS. To achieve the triple functions, the system must be readily and timely available and accessible, thus the employment of web technology in the design for operating system (o/s) independent and cost-effective system which can be easily accessed through any platform parallelly by all users (terminals) across the three Senatorial zones.

Education required for national progress and development must gear towards creating self-reliance in individuals who can gainfully engaged in sustainable businesses. Individuals who should not solely depend on government for earning a living. This can only be achieved by skill acquisition which is a systematic and sequential development of skills that promotes efficiency and effectiveness in job performance (Umeh, 2021). Researches have ascertained that several factors ranging from poor funding, inadequate facilities and skilled teachers have been a great obstacle to actualization of qualitative education in Nigeria (Okoye and Arimonu,2016; Undiyaundeye and Out,2015). Many researches (Egbeyemi and Enilolobo, 2022; Enang, and Okute, 2019: Olumese, 2019) carried out on the influence of social media and internet facilities on digital skill acquisition especially on Business Education students affirm their great impact on equipping the students with skills needed for effective performance in labour market. Most important for computer skill acquisition is the variety of activities users engage in, not their formal training, and not whether they perform instrumental or non-instrumental activities (Kolko *et.al*, 2013 ). McNitt et.al. (2015) illustrate how the use of technology, software, and experimental-based engineering tools has facilitated skill acquisition and improved the performance of skills essential for competition in gymnastics, track and field, basketball, and volleyball. Onuoha et.al. (2013) developed an E-Skill Information Acquisition Software (ESA), e-skill transfer using software for simplified skill acquisition. The software enables users to learn new skills such as paint production online. This like other virtual skill acquisition media does not provided needed material for the learners to practice what they felt they have learnt. Production of software teaching skills was put together to enhance teachers effectives and professional development in Hamza et al. (2018). The package contains components of teaching skills which are ten (10) major problems identified through research with basic school teachers. The study in (Olayinka and Eze, 2019; Olumese,2019) examined the influence of e-learning and social media on skill acquisition and academic performance using Business Education students in different higher institutions of learning in Nigeria. The studies adopted a descriptive survey design and findings reveal that the use of social media platforms and e-learning positively influenced skills acquisition. Nbina (2011) highlights the interest and different skills which are imperative for pupils in science and technology. It discusses strategies for skills acquisition, and how learners can be motivated to acquire science and technological skills. In Oduma *et.al*.(2019), the e-learning platform was examined reflecting on the collaborative learning, informal e-learning, computer-based training, (CBT) and well-based training as the e-learning platforms in business education. The benefit of e-learning platform, as well as e-learning skills acquisition were also discussed. Few works on class and timetable scheduling systems were also reviewed to be equipped with sufficient information used in designing the allocator module of the proposed system. The reviewed works include proposed algorithm for generating school lectures schedule using heuristic approach by Anirudha *et.al.*, (2012). Khayee and Botangen (2014), a class-scheduling system for collaborative preparation of schedules among several users, integrating five components: the data management module, course assignment module, scheduling module, result storage module, and the report module. Dipesh *et.al*. (2015), Shraddha *et.al.* (2018) and Kehinde and Michael (2019) used genetic algorithm to find solution to timetable scheduling. The reviewed works revealed the crucial need of skill acquisition for the young school leavers or graduate for responsiveness in labour market and national economic development. The various efforts made by educators and instructors at different levels which unfortunately have not yield significant result because of inability of the government at both local, state and national levels to support these efforts with substantial facilities, thus this study that aim at providing the platform for easy provision of these facilities for maximum utilization.

## MATERIALS AND METHOD

This research was carried out using object-oriented analysis and design methodology (OOADM) which is use-case driven, architecture-centric and iterative. The data collected on various skill acquisition/entrepreneurship subjects in secondary schools in Delta state and their pedagogical styles using structured questionnaire in Omede and Okpeki (2019) with which the hardware framework was designed was used. Other sources of data are academic journals and internet. The proposed Realtime ATTRESS system meant to drive ATTRESS hardware framework is designed using modular structure. The entire system task is broken into subtasks which are addressed by modules. Each module carries out an individual task. The same data collected for the design of ATTRESS were used for this complement system. The system was modelled using Unified Modelling Language (UML) tool. A 3-tier architecture was adapted for the online implementation of the proposed ATTRESS system. This is a client-server structure with three components. The 1st-tier is the User Graphic Interface (GUI) on the browser page through which users interact with the system. It is structured to support remote access to the system. The 2nd-tier is the application logic tier where all the functionalities of the system are manged and controlled. The proposed ATTRESS web application interacts with the GUI and database in the database server to accomplish the triple function of Co-ordinating, Resource allocation and Information dissemination. The 3rd -tier is the data bank, all data for the system structured by the database residing in the database server. The choice of the 3-tier structure is for manageability and easy maintenance of the system.

**The Design of ATTRESS Realtime Management System (ATTRESS_RMS)**

This focuses on overall organization of the software, showing the interaction between different modules of the system.

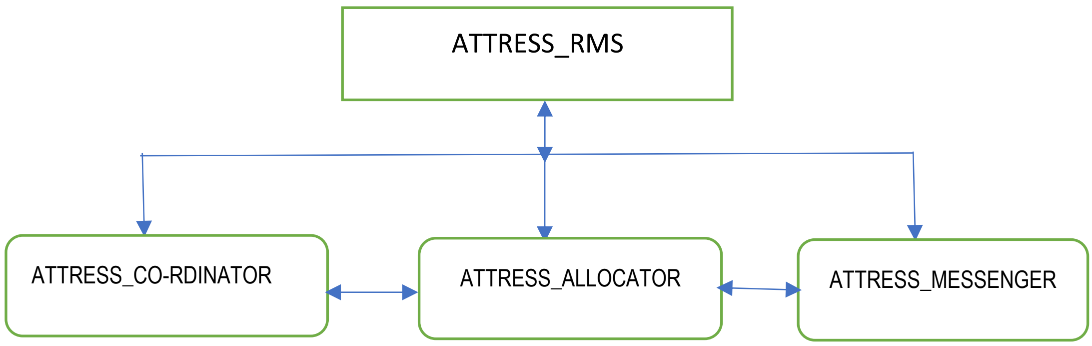


Figure 1: The block Structure of proposed ATTRESS_RMS.

The figure1 depicts the structure of proposed system composed of three subsystem each one regarded as a module. Each major process in this work is handled by a separate module, data management is handled by ATTRESS_Co-ordinator, Time and resources allocation is handled by ATTRESS_Allocator while instantaneous message dissemination is handled by ATTRESS_Messenger.

ATTRESS_Co-ordinator:

- Captures records of all schools and equipment in each zone
- Keeps inventory of the Consumables and depreciation of the fixed assets
- Manages the information system, keeping track of maintenance status of the equipment/tools
- Generates reports on activities in all the senatorial zones
- Prompts for Refill, Repair or replacement for equipment/tools

ATTRESS_Allocator

- Create groups for the participants
- Allocate time and resources to the groups

ATTRESS_Messenger

- Sends and Receives messages from all terminals.

**Modelling ATTRESS_RMS**

Let X represent the proposed ATTRESS Manager and T set of tasks to be carried out in X.

So T is direct subset of X and can be represented thus:

$$X = \{T\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$For\ i = 1\ to\ n\ where\ n\ is\ no\ of\ tasks$ (each task represents a module in this system)

$$X = \{t1, t2 \ldots tn\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The function $F(X)$ is a set of ATTRESS manager containing other subtasks (modules), thus

$$F(X) = F(t1, t2, \ldots, tn) \ldots\ldots\ldots\ldots\ldots (3)$$

In this system, $n = 3$, corresponding to the three modules $t1, t2, t3$ representing ATTRESS_Co-ordinator, ATTRESS_Allocator and ATTRESS_Messenger respectively. The equations $1\ to\ 3$ are pictorially depicted in Figure 1.

**A. Top level model of the proposed Web-based ATTRESS_RMS.**

Figure 2 shows the 3-tier top-level architecture of the proposed system which comprises of the User interface which is the top presentation, the web service through the user connects to the system. The middle layer; Application /web server which contains all the logics use for the manipulation of the data from the database to satisfy users' requirements. Finally the database server which houses all the data

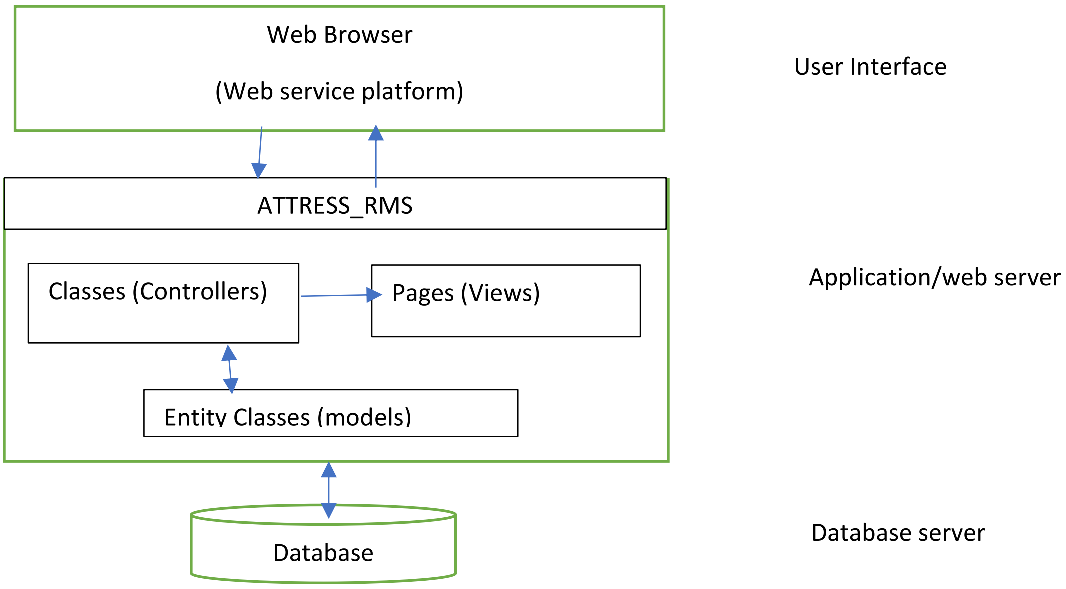


Figure 2: The top-level component of the proposed Web-based ATTRESS_RMS.

**B. The proposed system Use case diagram**

.The use case diagram shows the interaction between the system and the external entities to the system which are usually refer to as Actors. Actors can be human users, external hardware or other systems.

Actors in the proposed system are Terminal users (schools), the Sub_admin (Senatorial zones) and Admin (State level). The terminal user logs into the system to view the schedules, to know the time and resources allocated to the school, while the Sub_admin in each senatorial zone logs it the system to create account for all participating schools and also update thedatabase for each zone. The Admin is the administrator of the entire system who oversees the activities of all the senatorial zones and update the State central board on relevant information.

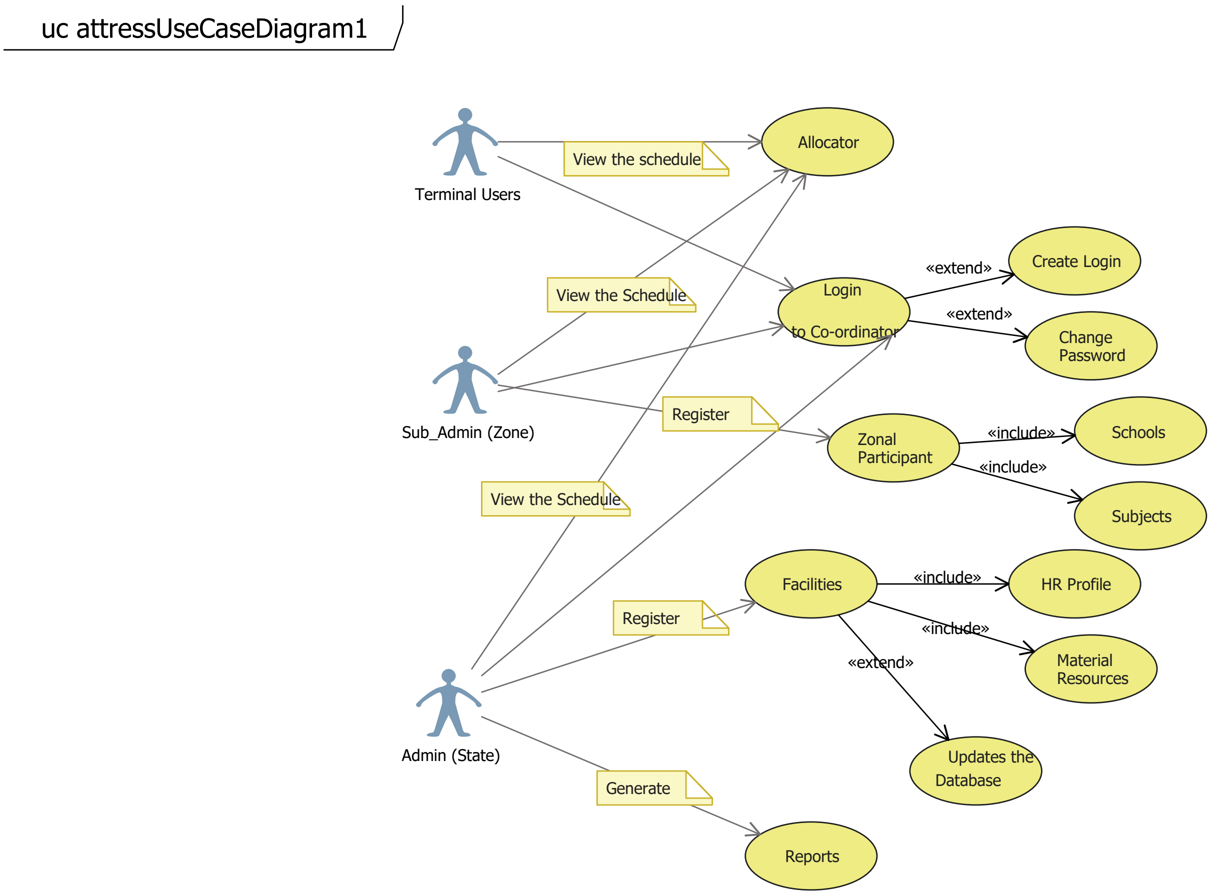


Figure 2: ATTRESS Use case diagram

**C. ATTRESS Activity Diagram**

In modelling the activities of the proposed system, a swimlane was used to partition the three modules of the system showing their activities as is depicted in Figure 3.

The coordinator module allows user's account to be created with assigned roles (admin. Sub_admin or participant). The role controls the activities that can be carried out by individual user. The admin role is the highest role that permits creation and assigning of Sub_admins role, registration and updating of facilities in each senatorial zone and also gets access to zones to monitor different activities going in the three senatorial zones. The role of sub_admin allows the registration and updating participants, instructors and courses. The role of participant allows the viewing of pages to get information on scheduled time and classes. The Allocator module groups the registered participants(schools), allocate time and resources to each group while Messenger module obtain scheduling information from Allocator and send it to participants.

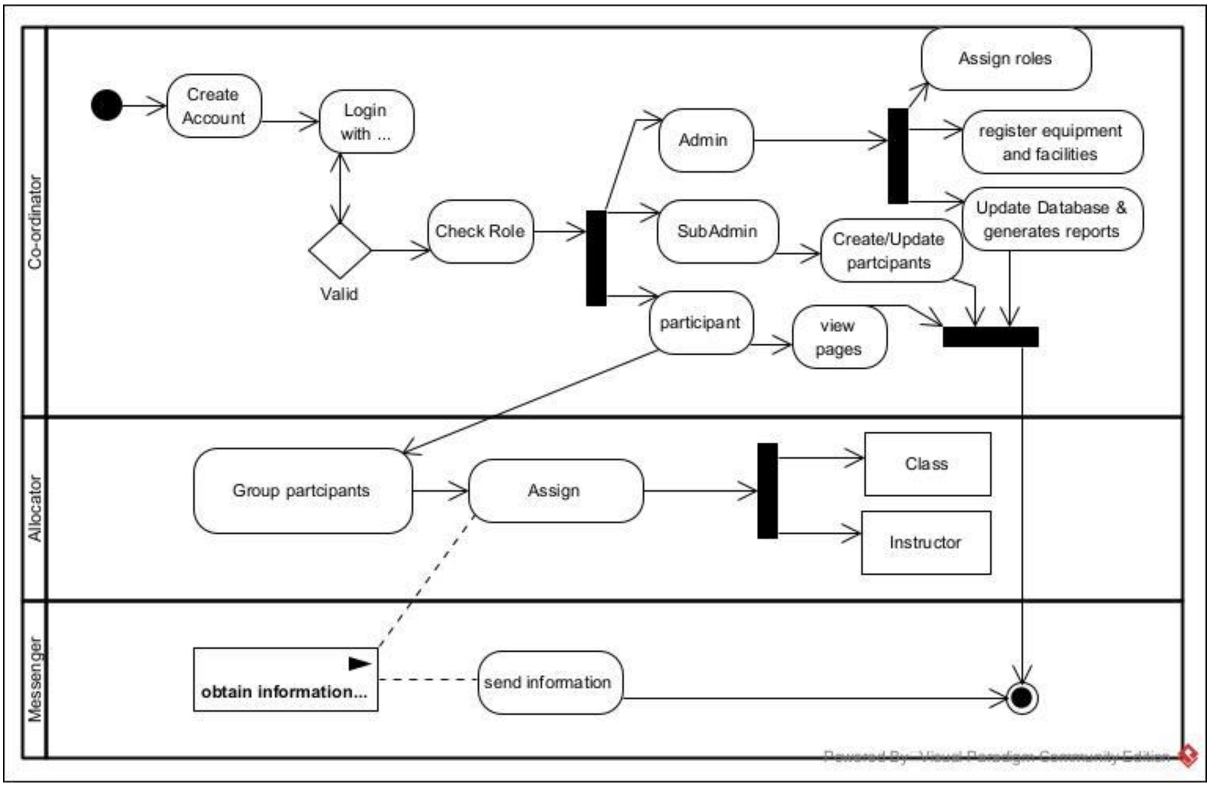


Figure 3: The proposed (ATTRESS) Activity diagram.

## D. ATTRESS Sequence diagram

The Sequence diagram shows the interactions between different objects and sequence of actions in the system to accomplish a user's requirement.

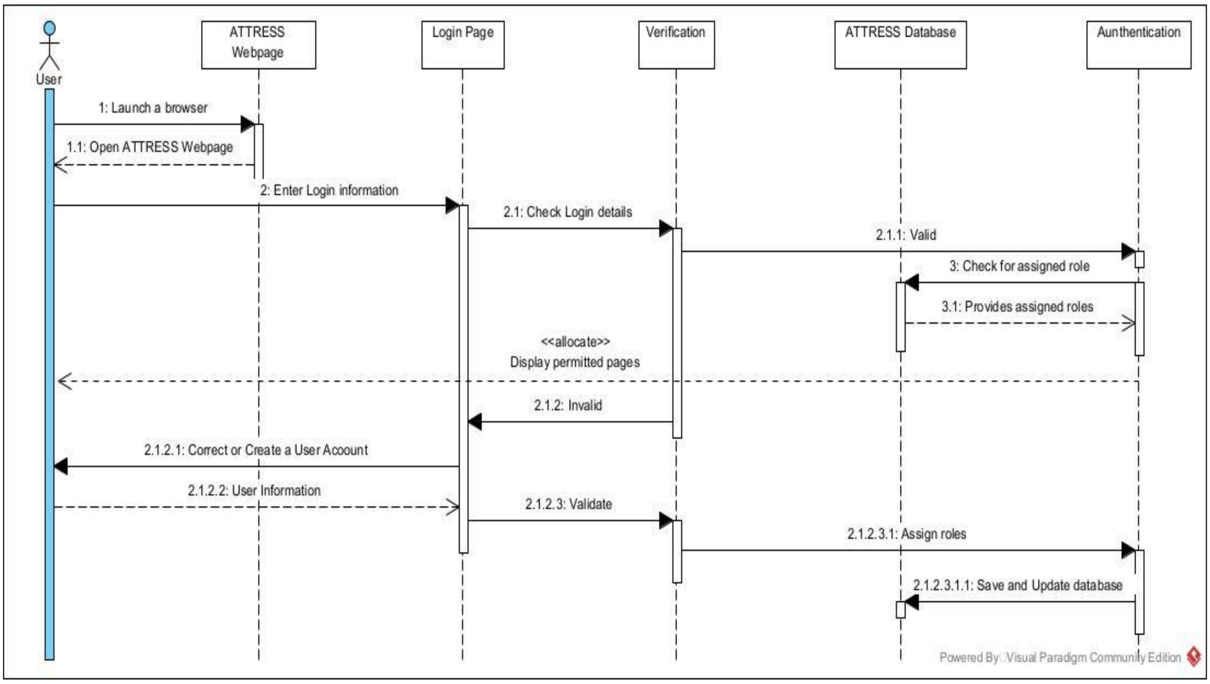


Figure 4: The proposed (ATTRESS) Sequence diagram.

**Modelling of the ATTRESS individual components.**

ATTRESS_RMS is a tripartite system consisting of three modules, Co-ordinator, Allocator and Messenger. In this section, the activity in each module is modelled.

**A. ATTRESS_Co-ordinator**

This module is for coordinating the activities in the different zones, ensuring availability and maintenance facilities(instructor and working materials both fixed assets and consumables)**,** by constant updates and realtime generation of reports on facilities status.

i. ATTRESS_Co-ordinatorUsecase diagram

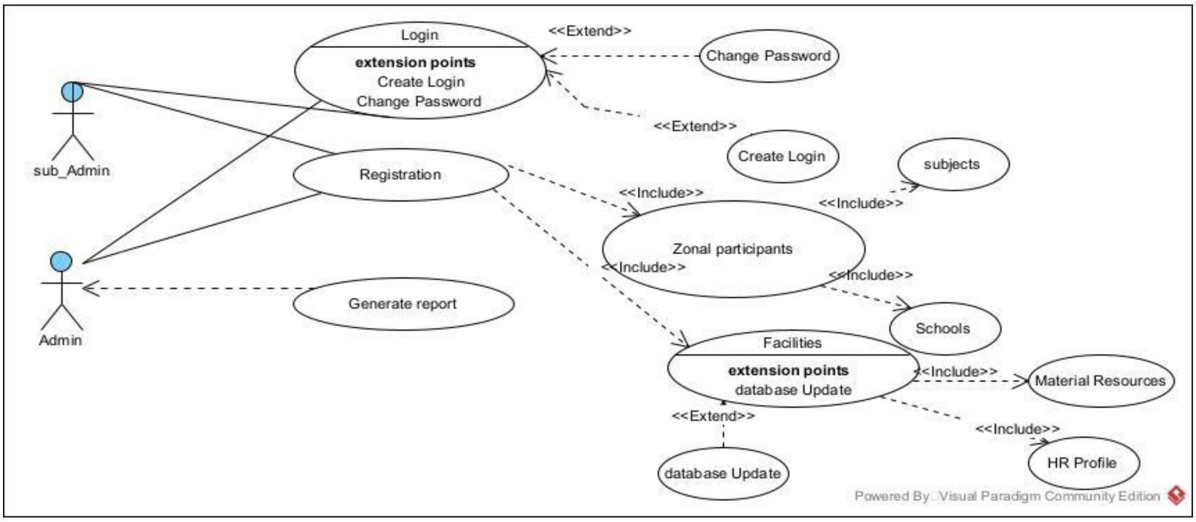


Figure 5: ATTRESS_Co-ordinatorUsecase diagram.

Figure 5 shows the interaction between the users (Admin, and Sub_admin) with the module. Both users can login into the system, while the sub_admin of each Senatorial zone registers the schools (participants) and their corresponding subjects for his zone, the central Admin registers all available facilities (equipment/tools both fixed and consumables, and instructors)in each of the zones .

*.AlgorithmI: for ATTRESS_CordinatorEquipment/Tools Management*

*Input parameters: Equipment/tool's tag/ID,*

$Type, T\ (has\ two\ values;\ F\ for\ Fixed\ Asset, C\ for\ Consumables); Acquired\ date, D_A; Acquired\ quantity\ Q_A;$ $quantity\ use\ per\ day, Q_u;\ Asset\ cost\ \ A_c$

$For\ n\ number\ of\ equipment\ in\ a\ zone's\ practical\ centre;$

$i\ =\ 1\ to\ n$ *(that is equipment type)*

$If\ E_{iT}\ =\ C\ then$

$Initialize\ \ Q\ _{ei}\ and\ Q_r\ to\ zero;\ Q\ _{ei} is\ the\ quantity\ of\ equipment/tool/material$

$Q_{ei}\ =\ Q_{ei}\ \ +\ Q\ _A\ \backslash\backslash Q_{ei} -\ quantity\ of\ consumable\ working\ tool\ i.$

$Qr\ =\ Qei - \ Qu\backslash\backslash Qr - quantity\ of\ Remaining\ consumable\ tools/materialsi.$

$If\ Qr < \ 3 *\ Qui;\ \ prompt\ for\ new\ order$

$Q_{ei}\ \ =\ Q_b$

$End\ if$

$Else$

$Calculate\ E_i\ depreciation\ value$

$SetE_i\ \ useful\ value\ to\ t\ (expected\ usage\ years\ for\ the\ equipment) and\ Salvage\ value\ to\ s$ $(equipment\ worth\ at\ the\ end\ of\ its\ useful\ years)$

$$Depreciation, D_{Ei} = \frac{A_c - s}{t}$$
$$Bookvalue\ = A_c - D_{Ei}$$
$$= A_c - \frac{A_c - s}{t}$$
$If\ Asset\ value\ has\ been\ exhausted, prompt\ for\ replacement$
$//check\ for\ maintenance$
$Accept\ Last\ Maintenance\ date, Md$
$If\ Cd - Md \geq Mp, send\ warning\ msg\ for\ maintenance$
$//Cd— current\ date\ taken\ from\ system\ date, Md— last\ maintenance\ date,$
$Mp\ - given\ period\ for\ the\ Equipment/tool\ maintenance$
$Next\ i$
$Stop$

**B. Modelling of ATTRESS_Allocator**

*i. Assumptions*

*Resources for different skill acquisition subjects comprise of equipment/tools/materials and instructors are taken as classes.*
*Time slot is a period of 3hours for each practical and practical for each day starts from 8.00am to 5.00p.m(Nigeria time) from Monday to Friday.*
*Schools comprise of groups of students for different classes*

***ii. Indices***

$i\ = 1 - 3\ (Zone\ index), \quad i \in I\ \{1 \ldots 3\}\ 3\ Senatorial\ zones\ in\ Delta\ State, Nigeria$
$j\ = 1 - m\ (school\ index), \quad j \in J\ \{1 \ldots m\}\ m\ number\ of\ schools\ in\ Zonei$
$k\ = 1 - n\ (class\ index), k \in K\ \{1 \ldots n\}\ n\ number\ of\ classes\ in\ a\ zonei$
$l = 1\ - n\ (students\ index), l \in L\ \{1 \ldots n\}\ n\ number\ of\ students\ for\ a\ classkin\ a\ zonei$
$x = 1 - a\ (group\ index),), \quad l \in X\ \{1 \ldots a\} a\ is\ number\ of\ groups\ for\ a\ Classk\ in\ Zonei$
$t = 1 - 15\ (Timeslot\ index),), \quad t \in T\ \{1 \ldots 15\}\ number\ of\ Timeslots\ per\ week$

***iii. Parameters***

$Z_i ------ is\ set\ Senatorial\ zones$
$S_{ji} ---- set\ of\ school\ j\ in\ zone\ i$
$C_{ki} --- set\ of\ class\ k\ for\ zone\ i$
$G_{xki} ----- set\ of\ group\ x\ for\ a\ class\ k\ in\ zone\ i$
$Decision\ Variable$
$Pt = f(G_l k_i) ------ Time\ slot\ allotted\ to\ group\ l\ for\ class\ k\ in\ zone\ i$

***iv. Constraints***

$Number\ of\ students\ in\ a\ group\ l\ for\ a\ class, k\ should\ not\ exceed\ 90\%\ of\ class\ capacity$
$Neither\ instructor\ nor\ student\ should\ have\ two\ classes\ at\ the\ same\ time.$
$Time\ slot\ for\ each\ class, k\ should\ not\ exceed\ 3hours, and\ total\ time\ t\ should\ not\ be\ greater\ than\ 9hours\ per\ day.$

$AlgorithmII\ for\ Mapping\ of\ students\ S\ into\ practical\ groups\ G$
$For\ Z_i\ there\ are\ C_k\ classes,$
$z1\ has\ c1, c2, c3, \ldots\ cn, z2\ has\ c1, c2, c3, \ldots\ cn\ and\ z3\ c1, c2, c3, \ldots\ cn$
$the\ capacity\ of\ C_{ki} = W_{ki}$
$the\ total\ number\ of\ students\ for\ C_{ki} = E$
$g1(z1c1) \leq 90\%\ of\ w1,1$
$//\ group1\ of\ class1\ should\ not\ be\ greater\ than\ 90\%\ of\ class1\ capacity$
$thus\ g1(z1c1) + g2(z1c1) + g3(z1c1) \ldots gn(z1c1) = e1,1$

$/ \; e1{,}1 \;\; is\ the\ total\ number\ of\ students\ that\ registered for\ c1\ in\ z1$
$if\ the\ capacity\ of\ students\ for\ a\ class\ in\ sch1 \; < \; 90\%\ of\ class\ capacity,$
$merge\ with\ sch2\ for\ which\ capacity\ of\ sch1 \; + \; capacity\ of\ sch2 \; \leq \; 90\%\ of\ class\ capacity.$
$Repeat\ until\ g1 + \; g2, \ldots + \; gn\ for\ c1 \; = \; total\ students\ that\ registered\ for\ c1\ in\ z1.$
$AlgorithmII \;\; for\ Time\ scheduling\ for\ practical\ classes$
$Assign\ time\ slot\ t1\ to\ g1C_{ki}, t2\ to\ g2C_{ki} \ldots tn\ to\ gnC_{ki}\ using\ Linear\ mapping$

### C. Modelling ATTRESS_Messenger

The core function of this module is to send messages/notifications to users or set of users. (users in this context are schools and instructors). User groups are formed based on access privileges and senatorial zones.

#### i. ATTRESS_Messenger Use case

The use case diagram in Figure 6 shows the requirement from this module, which is simply for user to receive notifications and messages and respond accordingly.

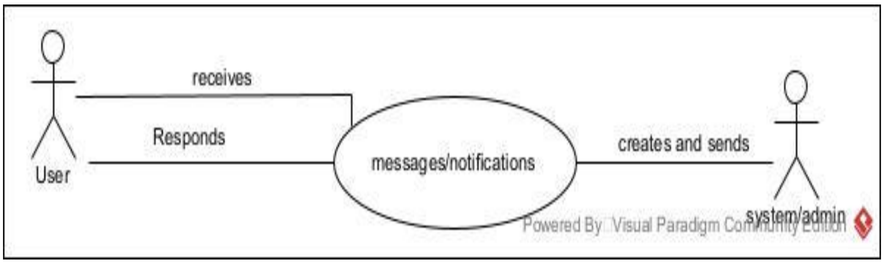


Figure 6: ATTRESS_Messenger use case diagram

#### ii. ATTRESS_Messenger class diagram

The class diagram shows the classes, their operations and relationship between the classes for this module.

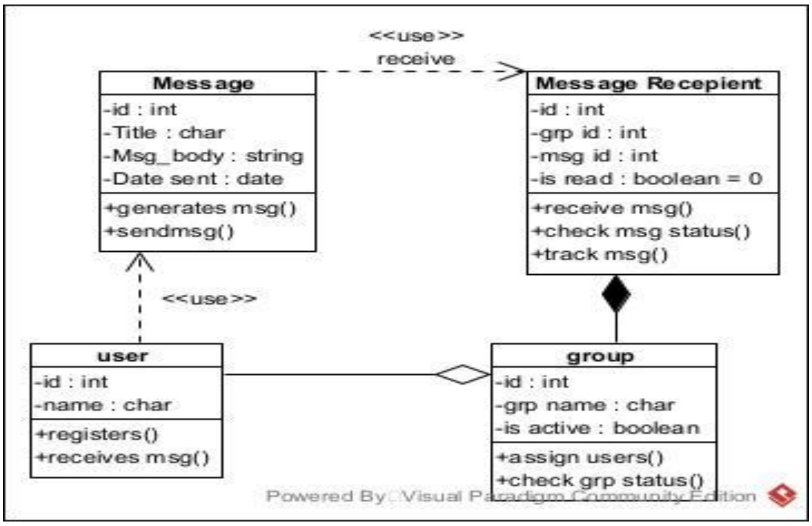


Figure 7: ATTRESS_Msenger class diagram

*Algorithm III for Message Creation and dissemination*
*Fetch report on schedules generated by Allocator from database*
*Assign msg.id to the report*
*Create date = current system date*

*Send message to user.email where user.id = grp.user_id and grp.id =Msgrecp.grp_id when create.date = allocation time – 1hour; Display on screen for 15mins, clear off notification.*

**Development and Implementation of the proposed ATTRESS_RMS.**

The integration of web technologies was used in the development of this system. Apache is used as web server, PHP/HTML/JavaScript as scripting language and MySQL for database. As a web application, the accessibility of the system by the users promotes collaboration within the three Senatorial zones.

The database was develop using MySQL, the schema is depicted in the class diagram in Figure 8 which contains the objects, their attributes and relationships.

**The Resource allocation and Scheduling process**

The ATTRESS_Cordinatorprovides platform for data input. This includes registration of participants (schools indicating the number of students for each subject), the instructors indicating their disciplines, the equipment/tools/materials in their different categories and quantities. Creation of Users account and roles assignment.

The ATTRESS_Allocator module, groups the participating schools based on the population of the students offering a particular subject. The population of each group should not exceed 90% of available equipment or working tools/ materials for a class. Each class slot has a maximum period of 3hours of the 9hours per day starting from 9.00am to 5.00pm (Nigeria time) from Monday to Friday. The

ATTRESS_Messengerreceives the output of scheduling from the Allocator and disseminate the information to all participants (schools) in form of instant message at their terminals.

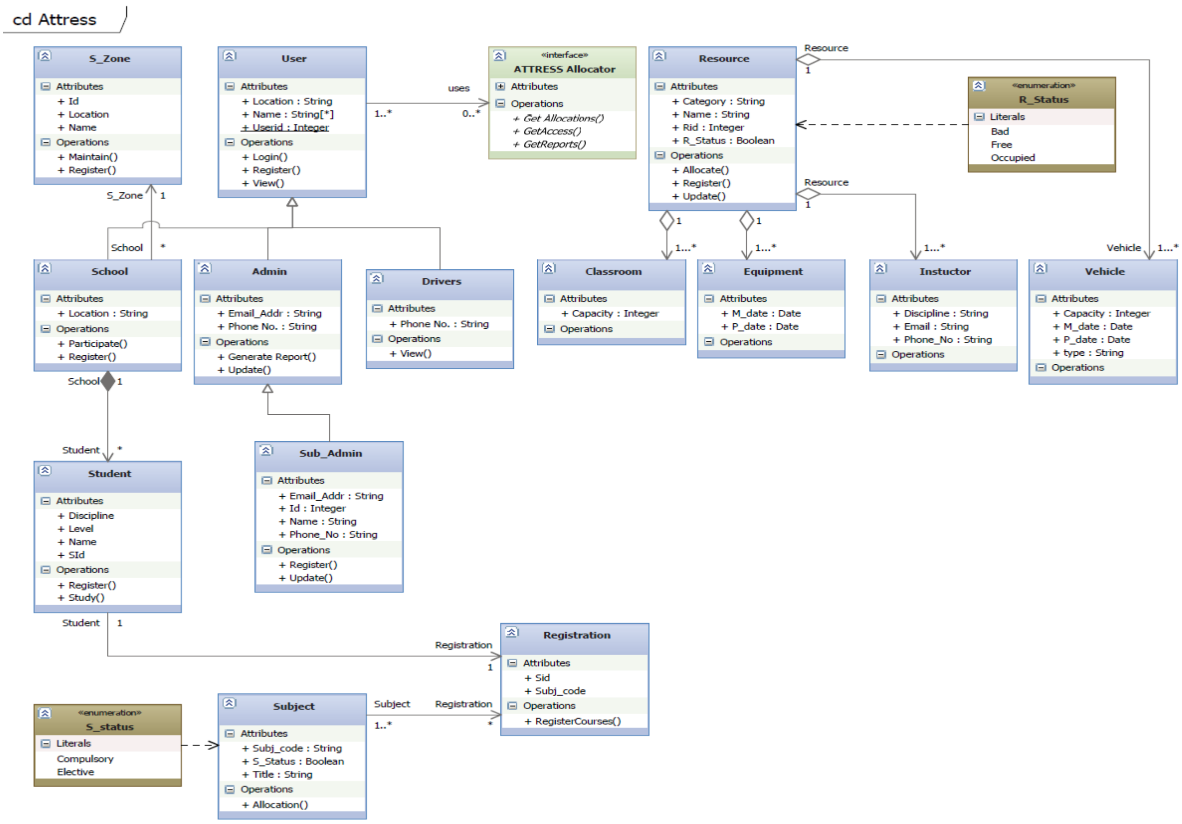


Figure 8: The proposed ATTRESS_RMS class diagram.

Samples of the input forms for the proposed system shown in Appendix

## RESULT AND DISCUSSION

Table 1: Test data for one senatorial zone

| Resources | Capacity | Students registration for each subject per school | | | | | Students population for a course |
|---|---|---|---|---|---|---|---|
| | | Sch1 | Sch2 | Sch3 | Sch4 | Sch5 | |
| Sewing workshop | 30 | 20 | 20 | 10 | 15 | 5 | 70 |
| Make up/Gele tying | 50 | 15 | 5 | 8 | 20 | 12 | 60 |
| Mechanic workshop | 20 | 10 | 0 | 5 | 15 | 0 | 30 |
| Electronic Repair workshop | 50 | 15 | 25 | 10 | 5 | 15 | 70 |
| GSM Repair | 30 | 12 | 8 | 15 | 5 | 20 | 60 |
| Data Processing centre | 100 | 30 | 40 | 25 | 30 | 25 | 150 |
| Office management | 50 | 5 | 30 | 10 | 15 | 10 | 70 |
| Soap making | 50 | 25 | 18 | 12 | 15 | 20 | 80 |
| Bead making | 60 | 12 | 27 | 11 | 20 | 15 | 75 |
| Catering Lab | 50 | 21 | 7 | 19 | 10 | 3 | 60 |

Table 2: : Resource Allocation generated by ATTRESS_Allocator algorithm

Time Schedule for different classes

| Classes | Slot1 | Slot2 | Slot3 |
|---|---|---|---|
| Bead making | Group1(54) | Group2(21) | |
| Catering Lab | Group1(45) | Group2(15) | |
| Data Processing centre | Group1(90) | Group2(60) | |
| Electronic Repair workshop | Group1(45) | Group2(25) | |
| GSM Repair | Group1(27) | Group2(27) | Group3(6) |
| Make up/Gele tying | Group1(45) | Group2(15) | |
| Mechanic workshop | Group1(18) | Group2(12) | |
| Office management | Group1 (45) | Group2(25) | |
| Sewing workshop | Group1(27) | Group2(27) | Group3(16) |
| Soap making | Group1(45) | Group2(35) | |

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The allocator module was able to form groups for the classes using less or maximum of 90% of the classes capacity per group for the class, and number of groups is determined by population of students that register for the particular skill which is regarded as class in this system. The information from this generated schedule is sent to each participant (schools) via email and on the screen at their terminal.

The proposed system was simulated and tested with sample data. It was locally hosted, Five schools with 50 students for different vocational and entrepreneurship subjects were registered from each Senatorial zone. The resources considered with estimated capacity are shown on Table 1.The test showed the effective performance of the system in seamlessly allocating resources (class, equipment and instructors) to all participants (schools) without collision. The integration of the system into the hardware structure earlier proposed will greatly enhance the efficiency of skill acquisition training in secondary schools by providing equal opportunity to all the secondary schools in Delta state to partake in the enabling skill acquisition environment provided by the government. It will on the other greatly reduce the economic burden on the government to make these resources available to all the schools in the state individually.

The Allocator model of the proposed system can be adopted for other scheduling activities like class and courses allocation for various departments in higher institution of learning to avoid collision of classes.

## CONCLUSION

This study designed a web-based real-time application to drive the previously designed Auto-Tech Resource Sharing System(ATTRESS). It is designed for triple function of coordination, allocation and information dissemination for collision free allocation of the resources to all participating schools and effective management of the resources in various zones. The adoption of this system will assist the State Government to provide all needed infrastructure and working tools for various skills at lower cost, giving all secondary schools in the State equal opportunity for practical-oriented education especially in the area of skill acquisition thereby achieving the dream of producing young self-reliant school leavers who can be gainfully employed without depending on the government.

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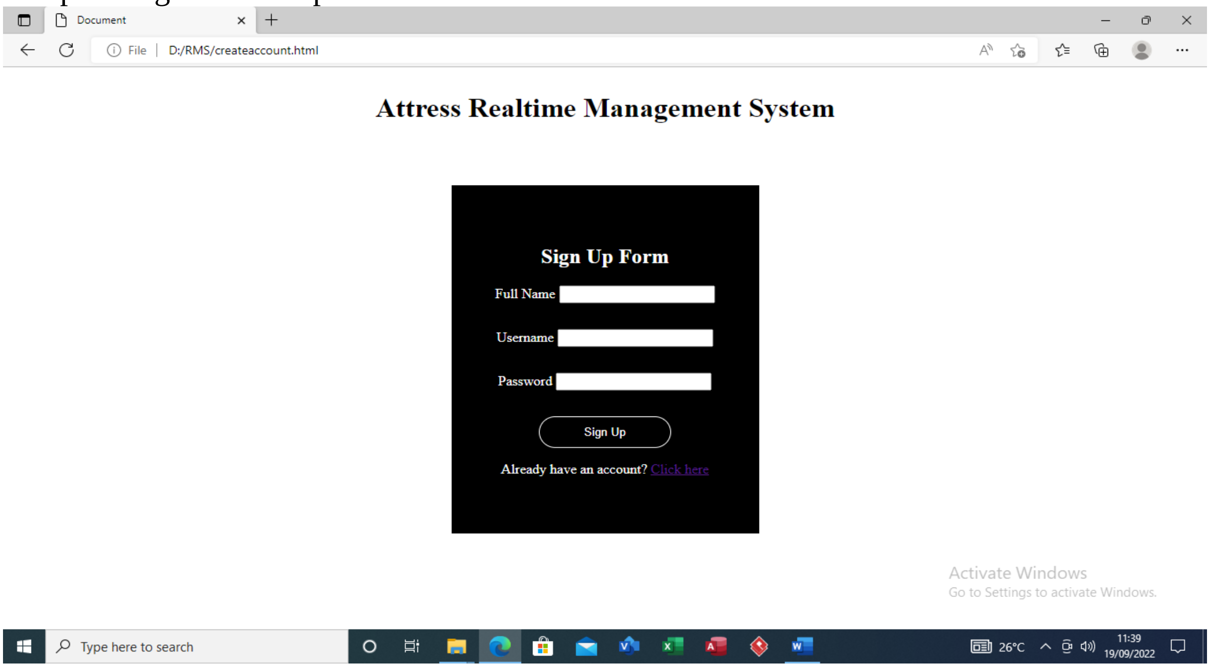
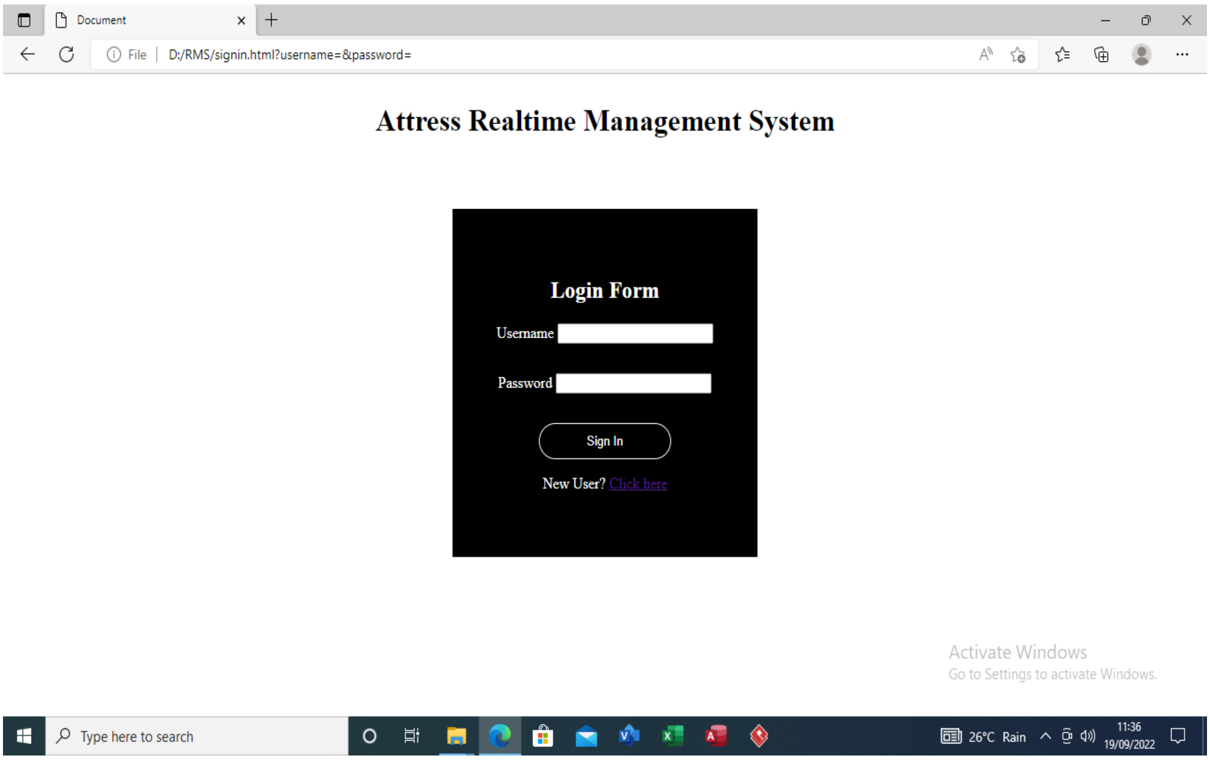
## Appendix

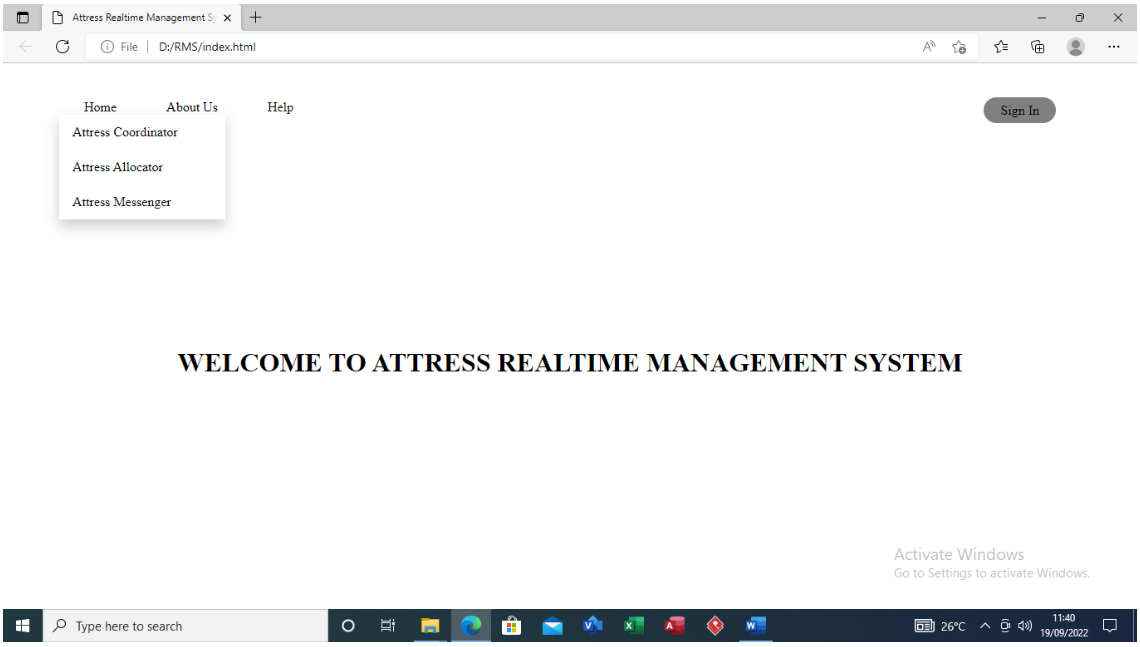
Samples of generated Input forms



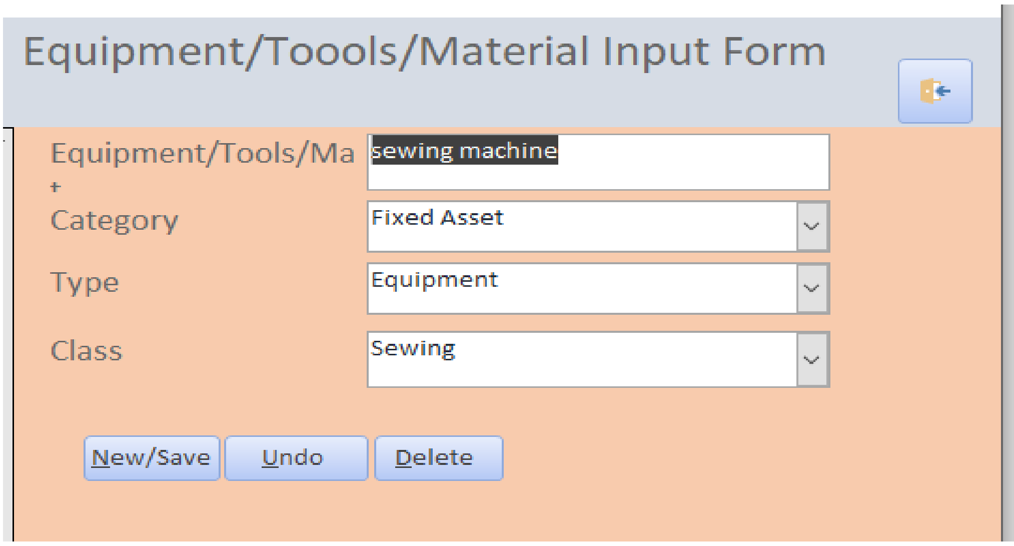

Account creation form.




Login form.




ATTRESS_RMS Home page




Resource input form

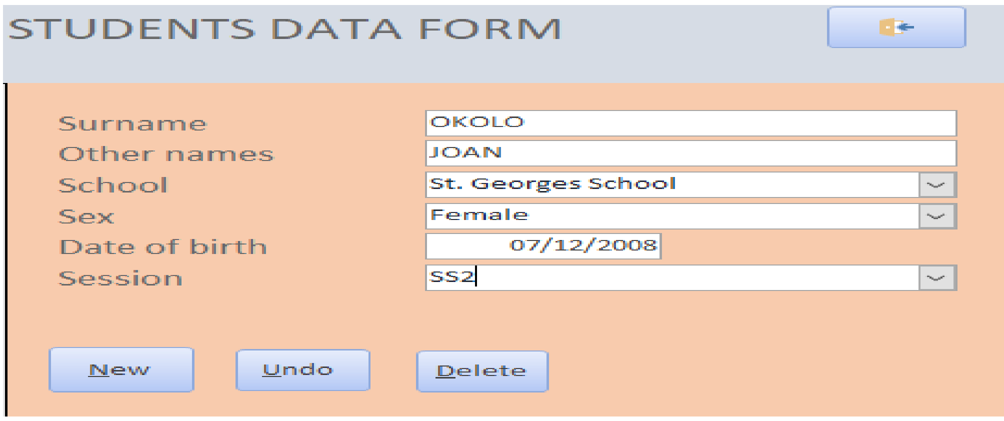



Figure 13: Students Data Entry form