

# Implementation of Basketball Multiplayer Remote Game for Education

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**Abstract**— This article features a remote experiment using remote controlling of a basketball game to facilitate learning in engineering. The experiment is integrated to the Smat Adaptive Remote Laboratory (SARL) system. This game lab experiment can be applied for Digital Design and programming courses as well. The students can use this lab from any location and using any type of device, the only requirement is to have internet access and a browser window. It can be used as the only lab or as an extension of the normal laboratory assignments. The interface offers different levels of difficulty. This work is presented a proof of concept for hybrid laboratories and favors the student learning in Digital design and, programming through the use of remote games from different locations.

**Keywords**—Remote Laboratory, SARL, Remote experiment, basketball remote game.

## I. INTRODUCTION

When searching for the etymology of the word "technology", you can see that "techno" comes from the Greek "TECHNE" that means "technical tools", and "LOGY" comes from "LOGIA" that means "study". The technology is study of the tools that can help humans.

Nowadays, technology is very important in people lives. For many people is vital the use of smartphones, computers or tablets. That is why industries are investing more and more money in producing technology and digital content for those devices, always trying to make life easier for people. For instance, the gaming industry is renewing itself every day providing new contents to user.

Video game industry is one one of the most profitable industries around the world (about 91 billion dollars in 2016) [1]. It outperformed the movies or music industries, but this growth is not recent. The video games have evolved and changed through the years starting from very simple video games during the 70's and reaching during the last decade high levels of realism and immersion .

## II. AUGMENTED REALITY

One of the technologies that is growing and developing is augmented reality. Where the real environment is mixed with

the virtual environment. For instance, the game Pokémon GO [2], In which you receive the Pokémon (Characters of the game) using the camera of the mobile device (cell phone or tablet). The game uses the camera to include virtual elements into the real scene. In this case, elements such as: the Pokémon and the game menu. Studies on augmented reality are not recent. The first research start in 1965 with the creation of the HMD (Head Mounted Display) by Sutherland [3].

However, we should not confuse augmented reality with virtual reality. Virtual reality is based on virtual objects providing an immersive experience. Augmented reality uses the real environment and adds virtual objects to it.

## III. GAMES

Games are part of everyday people life. They are classified in different types, such as: board games, digital games, gambling, sports, etc. Board games are games that use a board, a map or cards to play. Usually using dices and characters to play. Popular board games are: Strategy games (characters with different abilities or powers), Chess, Queens, The game of Life, Clue. One of the most played board games is Monopoly, where the goal of the players is to collect money and properties. The games that include money bets are classified as gambling games. For example, poker [4] must buy the chips to play, more examples are: Craps, Blackjack, slots and roulette.

Sports are games practiced collectively or individually, normally with the intention of doing a physical activity. There are some sports that require the use of external objects like balls or paddles For example, basketball, soccer, volleyball, tennis, ping pong, etc. There are another that does not include objects as part of the games such as: running, jumping, shooting, judo and gymnastics.

Digital games or electronic games are games that require a platform (computer, smartphone, video game console) to play. These games are currently the most popular due to the wide variety of genres and technology capabilities like the

online gaming. Categories of these games are: sports, racing, adventure, platform, strategy, role person games (rpg), etc. The development of these games generate a lot of job, because different people is required to do specific components of the games, and also generates indirect jobs, including employees of specialized stores, among others.

#### IV. IOT DEVICES

IOT devices are a reality. Today, you can control almost everything remotely through the use of internet. The principle of remote controlling is to execute a command without a physically contact with the equipment. The most common example is house assistants. Where the user use voice commands to control devices connected to the network. For example, turn on or off the lights, the air conditioner, the television, etc. For the experiment, it is essential to use the remote control. The experiment proposed make use of this technology for controlling, sending and receive commands and keep the communication to the SARL server.

#### VI. ONLINE LABORATORY EXPERIMENTS

The online laboratory experiments can be classified in 3 different types: remote labs, virtual labs (based in simulation) or hybrid configurations. The remote experiments are performed in a physical laboratory but using a remote access, commonly the users use internet to interact with the experiment. Normally these experiments use additional support component to make the project. According to Simao et. al [6] "The Remote Experimentation (RE) is a technology that allows the user to control remotely a real experiment, observing the results in real time."

The advantages of using remote laboratory experiments are: compared with local physical labs, remote labs can be accessed 24/7 from any place. they can implemented as low cost remote laboratory stations, compared with traditional labs, there is no need of having available equipped labs.

Disadvantages include: time delay between the user send the commands through the browser interface, and the command is received in the server and executed in the remote experiment, another disavange is the concurrency problems, being these

There is also virtual laboratory experiments, which are experiments similar to the real experiment but executed in a simulation software created in a computer. The advantage of using this type experiments is that this type of experiments do not need a physical laboratory (real) to run. Another advantage is do not have risks for the users because these labs do not make use of real lab elements. Disadvantage are: lack of experience in a situation of using a real equipment.

#### VI. RELATED WORKS

Exist some relatives works or similar to this article. For instance, the iLab-ISA of Massachusetts Institute of Technology (MIT) [8],the LabShare from Australia [9], GoLab Project from Europe and anothers.

The iLab is a platform of online laboratories using remote access. The iLab objective is help science and engineering learning. According iLab " The iLab Project is developing a suite of software tools that makes it efficient to bring online complex laboratory experiments and provides the infrastructure for user management" [8].

Already the LabShare is a project development by Australian government and the LabShare objective is a create a central ambient of remote experiments for the all Australian universities [9].

GoLab Project is a online platform developed by Europe with his objective is help students from colleges and high school using virtual labs activities out-of-class for learning more.[11]

Visir+ is a collaborative project from Argentina, Austria, Brazil, Portugal, Spain and Sweden. This project is a online experiment platform with remote experiments to electrical and electronic engineering learning using theory and practice experiments.[12]

The Square Off smart chess Board is a revolution on board games because using the tecnologic for 2 player play chess in differents places or differents countries in a same time.The chess use an app for connect the board with another board in other local. This chess is development in London UK.[13]

#### VII. SMART ADAPTIVE REMOTE LABORATORY (SARL)

Smart Adaptive Remote Laboratory (SARL)[7] uses a strategy in which the remote laboratory is aware of the users information, offering the necessary tools to allow the remote laboratories to gather information from the virtual learning environment (VLE), information such as: the student mastery level in certain topic, any required disability accommodations, the current level of progress in the course and the accumulated experience with that specific experiment

Based on this information and the values of the variables of the lab defined by the teacher, SARL can adapt the activities and complexity of the experiment. For this purpose, the laboratory interface asks the student to do specific activities and will change the controls, restricting the access to some commands or blocking the choice of configuring others. In this way, students can start using a simplified version of the remote laboratories experiment based on the difficulty level and their knowledge. With the increase of their knowledge, experience and mastery level, the remote laboratory will turn on more controls, increasing the complexity of the experiment.

Users access the lab experiment interface through SARM and they can send commands through web interface. According to Zapata-Rivera et al. [7]. The back-end of SARM support of both the Virtual Learning Environments (VLE) and the Remote Laboratories Management System (RLMS) in the adaptation of interface (view 1, view 2, view n) each interface is generated based on the student information retrieved from the VLE or stored in the same remote laboratory management system". This is described in figure 1.

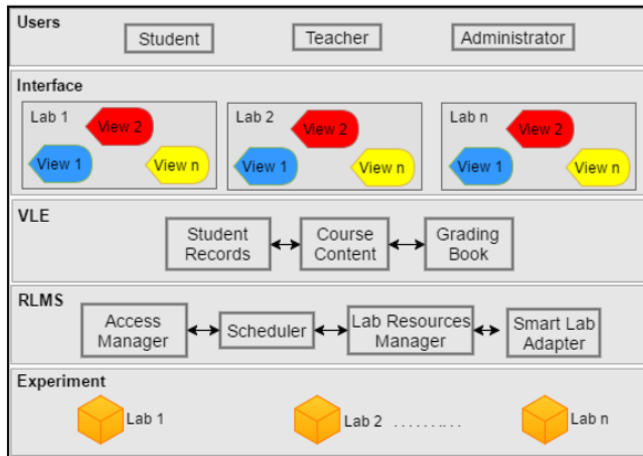


Figure 1 Describe interfaces and integration of SARM management system. [7]

The platform SARM include experiments with LED's, Servomotors, one of the experiments is to control a traffic light cross), each of the experiments have their own specific set of activities for the student's development.

This technology is being developed in web development languages (like HTML, CSS, PHP, JavaScript) and Python. Python is now the only development language the server accepts to control the experiments. Already the web development languages are used to create of interface between user and the experiments server.

The server has these features: storage the web interface, management of connected users, management of experiments, storage the student development codes and the student progress inside the platform.

As a server a raspberry PI 3 model B is being used, which has full capacity to handle all the functionality of the SARM. The raspberry PI in addition to being used as server. It is responsible for executing the commands so that the experiments work.

Different experiments are working now in the platform, for example experiments related with led's using PWM etc, a implementation of a traffic light cross system and the

proposed basketball remote game showed in this papers.

The following screenshots show the interfaces of the system such as: login interface gallery of labs and student profile

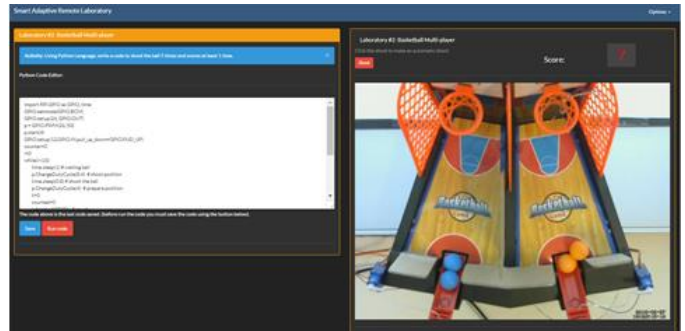


Figure 2 Basketball remote game



Figure 3 The Basketball remote game

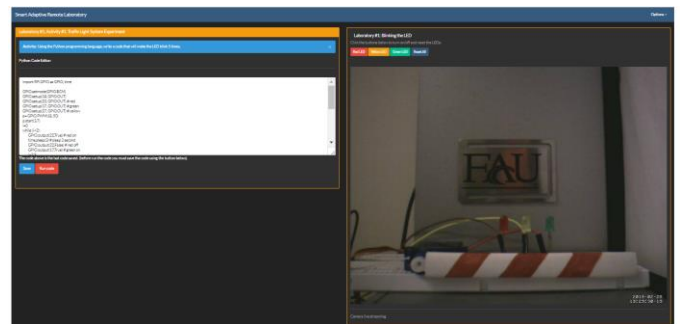


Figure 4 The traffic lights interface [7]

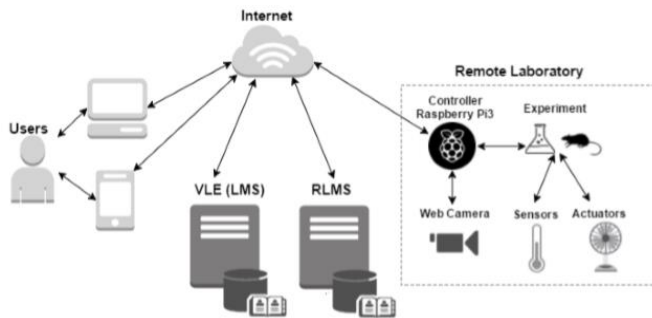
The actual idea is having connected a total of six different laboratories with different difficulties.

This type of experiments normally uses actuators, sensors, controllers, processors, storage and supportive components in its construction and operation. For instance, in the traffic light experiment was used A servo motors as actuator, LEDs that make mimics the behaviour of a traffic light (changing the color). Already the sensors are equipment that possibility to verification alteration in environment, as cameras, presence detectors. Controllers, processors and storage are devices with capacity to management, manipulate and operate systems

(hardware or software) using modules for helps as WIFI or ethernet cards.

### VIII. PROTOTYPE IMPLEMENTING A BASKETBALL GAME FOR SARL PLATFORM

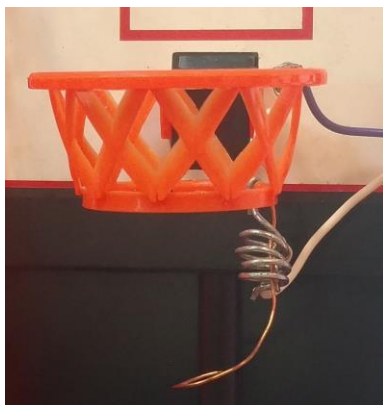
The basketball experiment follows the following architecture:



**Figure 5 Design of the SARL system.[7]**

To develop the basketball remote game was necessary the use of many support components, as clips, telephone cable and cables for connections.

The two paper clips were used to create the baskets counter sensor and the launcher actuator. The two different things created with clips were: First the spring to insert the telephone wire inside, these two components by combination creates a device is similar to a switch. This switch is responsible for counting the points in the game, It is localized below the hoop and is activated when a ball go inside the hoop and counts the point for player or computer.



**Figure 6 Hope switch.**

Another clip is used in the ball launcher device, between the servo motor and the base of launcher. This clip is responsible for strength and direction of the ball. The servo motor together with the paper clip acts a the arm of the basketball player. The user need to calibrate the force with

that the servo motor will launch the ball to hoop.



**Figure 7 The ball launcher device.**

The experiment has two different modes of use:

- Programming activities

Explain and include image interface lab2A1

- Multiplayer game

Explain and include image interface lab2A2

The experiment is also used as part of a hybrid laboratory for the logic design class, giving the student the possibility to connect the breadboard with the experiment for the class, in this case the counter laboratory and allowing the user to count locally the points of a real game happening in real time in the remote laboratory.

### IX. PROBLEMS AND RESULTS

The problems found in construction this experiment (Basketball remote game) are problems with the shot counter working correctly and find a good format for the clip localized on servo motor to this mechanism have a good accuracy on shots. In software case the problems found are how to have a good calibration values to send to servo motor shot the ball to the hoop in a perfect shot and to make with the counter (in python) send the value corrects to interface in php of the laboratory.

The results found in this project is create a platform functional that can help the students and the professors to learn more about logic, design and python development. In addition, the platform was developed for have a clean interface, responsible and with good UX (user experience) for the users.

### X. FUTURE IMPROVEMENTS

The platform is still getting improvements. For instance, the new interactive interface, more experiments and activities, the integration between the platform and a database where the

user data's will be saved, for more security process. Another improvement is on development is animations (similar to real laboratory) for used when laboratory is in use and another user need use this same laboratory.

## XI. CONCLUSION

Generating scenarios that integrate games as part of the online laboratory experimentation can leverage students motivation as well as provide real contexts of application of he concepts.

SARL system provides support for hybrids laboratories (between remote laboratories and virtual laboratories) still there is a long way in researches and development, having a vast amount of possible application areas for the implementation of this hybrid laboratories.

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