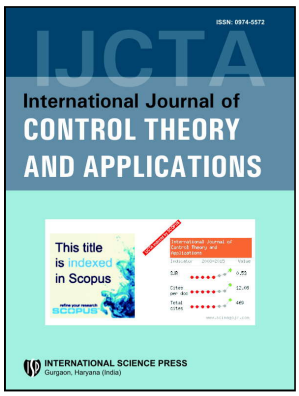

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RFID Based Virtual Laboratory

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Abstract: Throughout the years, the need for automatic identification systems has been on the rise due to its numerous possible applications in everyday life. Radio Frequency Identification (RFID) provides one such way of doing this. RFID technology has been around for over 50 years and it is only now that it has become cheap enough to be used as a throwaway inventory or control device. Due to this it can now be combined with various everyday items and can be used in Laboratories, Schools, Universities, Retail Outlets, Hospitals and Libraries etc. RFID Enabled Display System can help in automatic demonstration of an object through an Audio or Video Multimedia Information System. The fully automatic integrated display system will help in getting the detailed information of a particular object like a chemical substance in the laboratory, product demonstration, placement of purchase order in retail outlets, patient treatment, history in hospitals and account information in banks etc. using a centralized database while having the added benefit of assisting disabled people.

RFID based virtual Laboratory being interactive in nature could be used as a Smart Class system that would be of exceptional benefit to the students in School, Colleges and Universities. Being installed and Implemented in the Biological laboratories at various levels, the RFID based virtual Laboratory can be significantly beneficial, as it may decrease the risk of injuries caused by hazardous components and chemicals by supporting RFID Enabled chemical Reactions.

Keywords: Radio Frequency Identification (RFID), High Frequency Tags, low Frequency Tags, Ultra High Frequency Tags, RFID Enabled Virtual Laboratory, Smart Classes, Tags, Reader.

1. INTRODUCTION

Radio Frequency Identification (RFID) is a technique used for automatic identification [2] solely implemented by Radio waves. This involves reading and capturing of information with the help of a Tag being attached to an equipment. RFID is unique in nature as it uses radio signals to automatically identify the target thus making the system process complete without any physical contact, with the added benefit of providing access to relevant data

in real time and further supporting automatic identification of the equipment or object. RFID comprises of two main parts i.e. the Tag and the Reader. A RFID component [4] on the Tag contains a microchip and an antenna, for storing and processing information and for receiving and transmission of signal. These RFID Tags could be battery powered therefore known as 'Active Tags' [2] or could use the energy of the radio waves being transmitted to it which are known as 'Passive Tags' [2]. RFID Tag [1] receives an electro-magnetic field transmitted by some tracker equipment or reading unit. Upon activation using its power source, the Tag receives commands from the reading unit and further responds by sending its serial number for the capture of requested information. The Tag has to be continuously powered for this transmission. The field thus created is called a Continuous Wave.

Low frequency Tags though cheaper are sufficiently fast for most applications. High frequency Tags are expensive but have higher transmission rates. Ultra High Frequency (UHF) Tags also provide very high transmission rates but are also quite expensive. UHF possess the highest range as compared to other Tags, ranging from 3-6 meters to 30+ meters. Hence UHF is the most useful in automated systems.

Frequency Bands-

LF : 125 - 134.2 kHz and 140 - 148.5 kHz [3].
HF : Smart Tags (13.56MHz) [3].
UHF : 868MHz (Europe), 915MHz (USA), 950MHz (Japan), and 2.45GHz [3].

The RFID Based Virtual Laboratory involves reading and capturing of information with the help of a Tag further enabling an Integrated Display systems for automatic demonstration of comprehensive information about an object/substance through Audio and Video. Its standalone unit comprises of :

- A Small HF Reader module with Antenna and Embedded Motherboard with Microprocessor/SoC,
- A/V decoders. The Reader module and embedded board are interconnected through serial/i2c bus.
- A small footprint embedded OS with embedded browser using Linux, Android or Win CE.

A connection to the media/database server through Ethernet or Wi-Fi is quite similar to this. The HF Reader reads the product code from HF Tag, and being associated with the product it will send the product code to the Central server. Further the Central server on receiving the Product code from the HF Reader through LAN and sends the video stream and other information associated with the desired product and information.

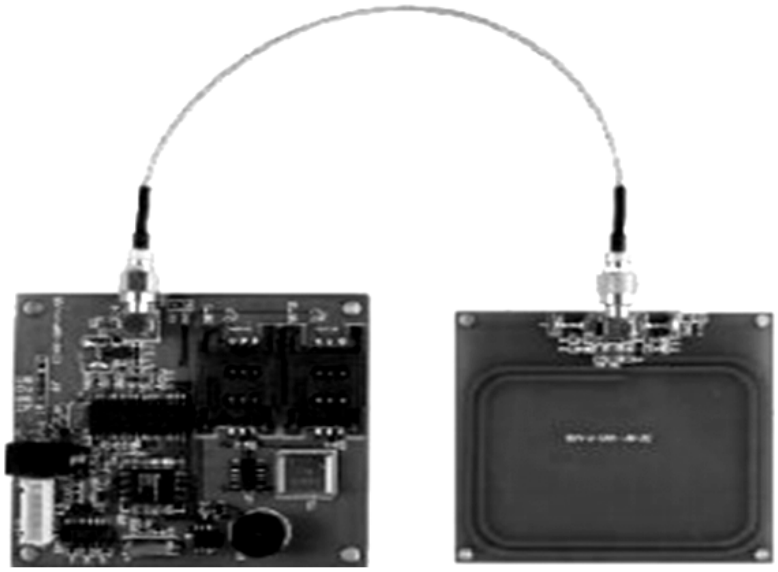

Figure 1: HF Reader Module with Antenna

The rest of the paper is organized as follows. Social aspects and Integrated Process are explained in section II and III respectively. Implementation is presented in section IV. Difference between the Bar Codes and RFID is explained in the section V and the Future Aspects are talked upon is section VI. Concluding remarks are given in section VII.

2. SOCIAL ASPECTS

With the expansion of technology, the need for smart solutions is growing tremendously. Breakthroughs have been witnessed with the development of smart cities. Smart homes, Smart communication systems, Smart transportation systems, Smart Virtual Environment and what not. But Smart teaching methods have still not been proposed on a higher scale.

Gaining knowledge is the foremost aim and need for a fruitful and successful life, and therefore methods should be proposed to increase understanding among students within schools, universities and also teachers

This could be achieved by using the RFID based Virtual Laboratories as it positively impacts our society by providing Smart solution to the day to day problems. Taking all this into consideration the development and implementation of The RFID based Virtual Laboratory will aid for the smart method of learning and teaching. Children being curios to know about new things can be aided with this technology, which will provide them an interactive audio and video session to learn things of their interest, with better explanations and understanding thus maximizing knowledge. The process of teaching could be revolutionalised as this technology would not need a teacher to be physically present at all times. The student can itself use the RFID Tagged components and Reader to get access to the Video Demonstrations. This smart teaching method being implemented in the Biological Laboratories could be a great alternative to using hazardous chemical compounds that would decrease the probability of any mishap especially among children, and on other hand would provide a detailed description about the reactions performed i.e. the products formed after the reaction, the molecular structure of compounds accompanied with a visual demonstration of how atoms and molecules break and combine to form new compounds during a chemical reaction.

3. INTEGRATED PROCESS

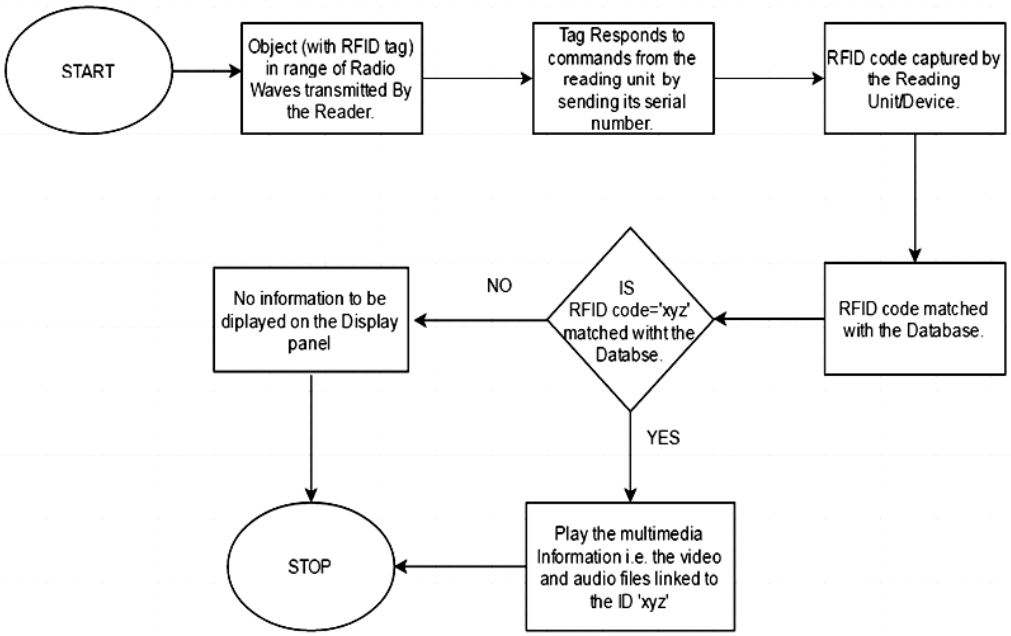

Figure 2: Flowchart for RFID Based Virtual Laboratory

The working process involves detection of the object with a RFID Tag through Radio waves being transmitted by an HF Reader.

- Before implementation of this process one is suggested to have at least 2 or more RFID Tags along with an HF Reader panel.
- Connect the HF Reader unit to the USB port of the computer.
- If the object is in range of the radio waves transmitted by the Reader, or is placed on a Reader pan the Tag responds to the received signal.
- Further the Reading pan reads the object's RFID code for e.g. RFID code = 'xyz' and this RFID code is captured by the HF Reader at the USB port of the computer.
- This process of getting the data from Tag by the Reader is called 'The Back Scattering Process' [2].
- RFID code is then matched with the database i.e. RFID code = 'xyz' matches with an entry in the database or not.
- If yes, the video saved with the file name same as the detected RFID code is played and post the completion of the video this process stops.
- Else if the RFID does not match with any of the files in the database, no video is played on the display panel the process halts.

RFID Tag detection continues for other objects in range.

4. IMPLEMENTATIONS

RFID Based Virtual Laboratory being an extension to the classic RFID information generation method is highly interactive, thus enhancing its Implementation and usage in various fields ranging from schools, laboratories to even complex security platforms. Involving a multimedia display, the system displays multimedia information content such as videos, audios and images stored in the database corresponding to the RFID code associated with the scanned Tag with much detail. Such interactive experiences increases the user's level of understanding and also increases the probability of innovation with further usage. Some practical day to day usage categories of RFID Based Virtual Laboratory are listed below.

4.1. To identify the outcomes of a chemical reactions between the chemical compounds

This involves the use of a Reading pan (Reader) over which two or more than two compounds could be placed. Upon detection by the Reader pan the system will provide all the information of a chemical reaction between the compounds that were being placed on the pan. This information will involve video demonstrations on the display panel assisted with audio for better understanding as shown in Figure 3.

4.2. Identification of characteristics of the chemical compounds

This involves the use of a Reading pan (Reader) over which an element or compound is placed. Upon detection by the Reader pan the system will provide complete information about the element placed on the display panel assisted with audio and video as shown in Figure. 4

4.3. Pollen germination in flowering plants

This involves the use of a Reading pan (Reader) over which two flower dummies are placed. Upon detection by the Reader pan the system will provide complete information about the pollen germination process on the display panel assisted with audio and video as shown in Figure 5. This could be readily used for teaching purposes and also scientific demonstrations.

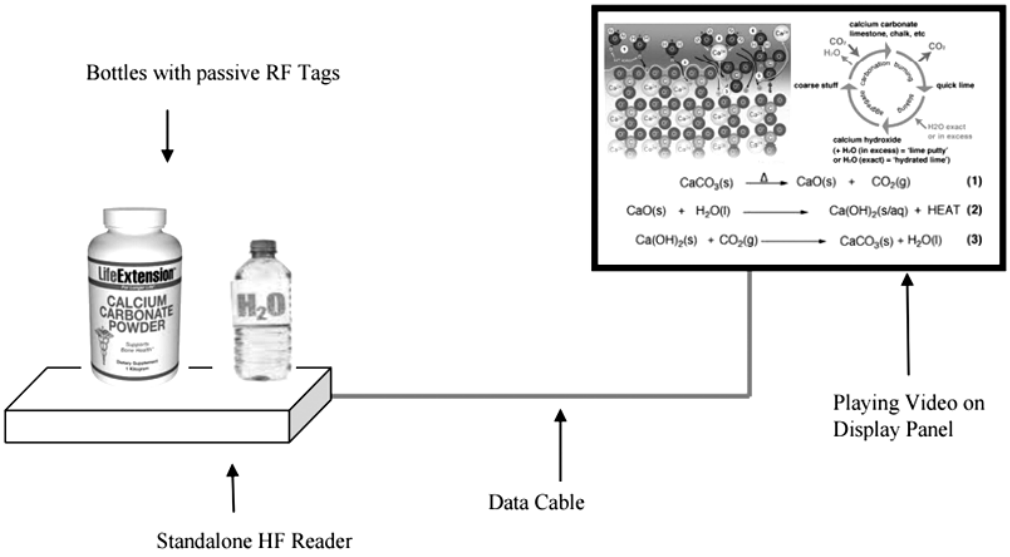

Figure 3: Detection of compounds and audio-video demonstration of their chemical reactions.

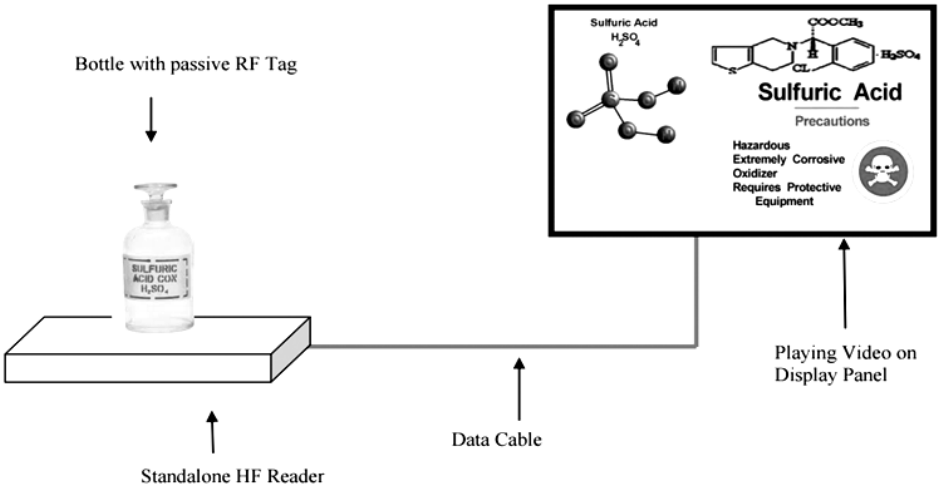

Figure 4: Recognition of characteristics of chemical compound.

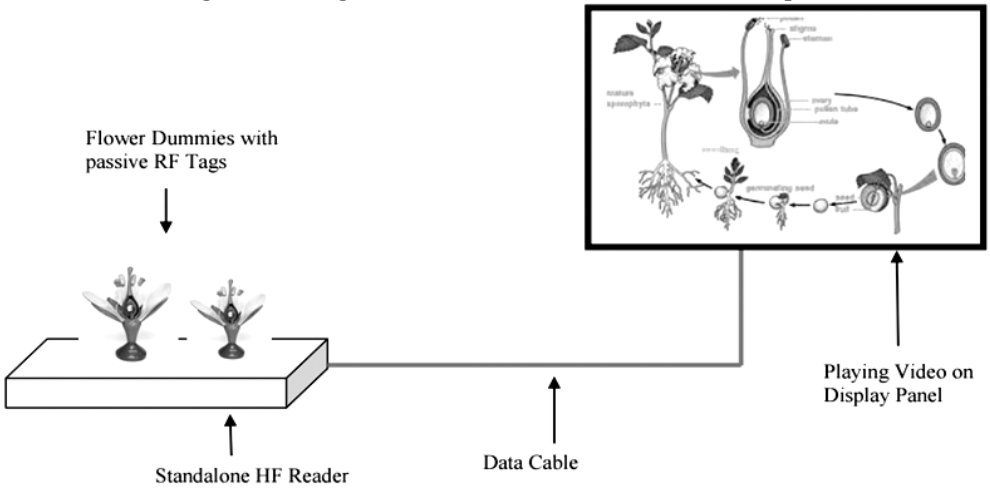

Figure 5. Demonstration of pollen germination in plant.

5. RFID VS. BAR CODES

RFID Tags and barcodes are both physically associated with objects or products thus supporting automatic identification and display of information.

RFID Tagged devices do not need to be positioned precisely relative to the position of the Reader or the scanner device as it supports communication without any physical contact i.e. RFID devices will work within the radius (up to 20 feet for high-frequency devices) of the scanner/Reader whereas a Bar Code [3] requires line of site transmission thus leading to some difficulties in the completion of process.

Being available for 50 years yet RFID technology has not been that prevalent in everyday use, it is now that advancements are seen in this field and manufacturing of RFID devices is up to an extent that it could be considered as a "throwaway" inventory or control device. Lack of standards is the sole reason that the RFID devices took so long to get into common use. Also RFID Tags can provide read/write facility which is not supported by the Bar Codes.

6. FUTURE ASPECTS

The authors are currently working on implementation of the proposed RFID based virtual Laboratory. Before Implementation of the proposed work some other parameters like Range and connection of Database need to be investigated. These parameters will result in a better interactive user interface, increase in processing speed with increased accuracy in results and therefore avoiding any accident.

7. CONCLUSION

RFID based virtual Laboratory uses automatic identification of the object using Radio Waves which supports the process to complete without any physical contact and thus makes this system Robust. This system could be implemented to add advancements to the classic methods of teaching. It makes learning interactive and more accessible.

RFID based virtual Laboratory system is an upgrade to learning process which incorporates video and audio lectures and lessons along with the identifications of objects. This makes it completely hassle free and easy to use providing great benefits to the students studying in schools, colleges, universities. It is a onetime investment i.e. once installed in a laboratory it requires no more costs and also decreases the money spent on buying chemicals and compound as it supports demonstration of chemical reactions, properties of compounds and even more

Considering the versatile strengths of students and their Imaginative powers which may be not be the same for every one of them, the RFID based virtual Laboratory system uses video explanation assisted with audio thus adding up to their imagination and increasing the ease of understanding so that no student lacks behind.

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