

# Automatic Energization of a Library using Arduino

<sup>1</sup>Grace Joseph <sup>2</sup>Theres Garvasis <sup>3</sup>B. Nithya

<sup>1,2</sup>UG student <sup>3</sup>Assistant Professor

<sup>1,2,3</sup>Department of Electrical and Electronics Engineering

<sup>1,2,3</sup>Christ the King Engineering College, Coimbatore, Tamil Nadu

## Abstract

There are many technologies developed for controlling the libraries in order to save energy. One among such technology is the automatic energization of a library using arduino. The automatic energization makes the library more user friendly. When the smart card given to each person is swiped, automatic registration of personal details will occur and the door opens simultaneously. The devices like lights, fans and computer system can be automatically switched on by sensing the presence of the user. The modified system is to control the wastage of energy in a library and reduce the effort of workers.

**Keyword-** Radio Frequency Identification (RFID), Wi-Fi Module, Internet of Things (IoT)

## I. INTRODUCTION

### A. Wi-Fi Module

Wi-Fi or Wi-Fi is a technology for wireless local area networking with devices based on the IEEE 802.11 standards. Wi-Fi is a trademark of the Wi-Fi alliance, which restricts the use of the term Wi-Fi certified to products that successfully complete interoperability certification testing. Devices that can use Wi-Fi technology include personal computer, phones and tablets, digital cameras, smart TV, digital audio players and modern printers. Device can connect to the internet via a WLAN and a wireless access point. Such an access point (or hotspot) has a range of about 20 meters (66 feet) indoors and a greater range outdoors. Hotspot coverage can be as small as a single room with walls that block radio waves or as large as many square kilometers achieved by using multiple overlapping access points. Wi-Fi most commonly uses the 2.4 gigahertz (12cm) UHF and 5.8 gigahertz (5cm) SHF ISM radio bands. Anyone within range with a wireless modem can attempt to access the network; because of this, WiFi is more vulnerable to attack (called eavesdropping) than wired network. Security features of Wi-Fi protected access constantly evolve to include stronger protections and new security practices as the security landscape changes.

### B. RFID (Radio Frequency Identification)

RFID is a wireless non-contact system which uses radio-frequency waves to transfer data from a tag which is attached to an object, for automatic identification and tracking. It is a technology that uses the radio waves for transferring data from an electronic tag called as RFID tag. This tag is attached to an object or a thing that also contains some valid information about the respective object. The reader is used for identifying and tracking the objects. These RFID tags which can be read from certain distance far away have an advantage that it requires no line of sight, so that these RF (Radio frequency) waves can penetrate through the opaque objects. The information about the tag is stored (electronic basis) in terms of bits. The RFID tag includes a small RF transmitter and receiver through which the RF signals are transmitted and received. An RFID reader transmits an encoded radio signal to interrogate the tag. There are certain RFID tags which does not have a battery rather with the help of the RF waves from the reader is used as the energy source which is technically termed as passive RFID tags and rest which have battery present as energy source called as active tags.

#### 1) Basic principles of RFID

There are three key or the main components of an RFID system are tag, middleware and reader.

- RFID tags: also known as transponders or labels which are attached to the objects. Tags could be of active, passive or semi-passive. There are tags with memory that are available to store information in the form of bits.
- Reader: also known as transceiver (transmitter/receiver) made up of a Radio Frequency Interface (RFI) module and control unit. The readers are classified based on the frequency (LF, HF, UHF, etc.,) and also in terms of portability ( Fixed & Handheld). Their main function is to activate the tags, structure the communication sequence with the tag and transfer data between the application software and tags Middleware.

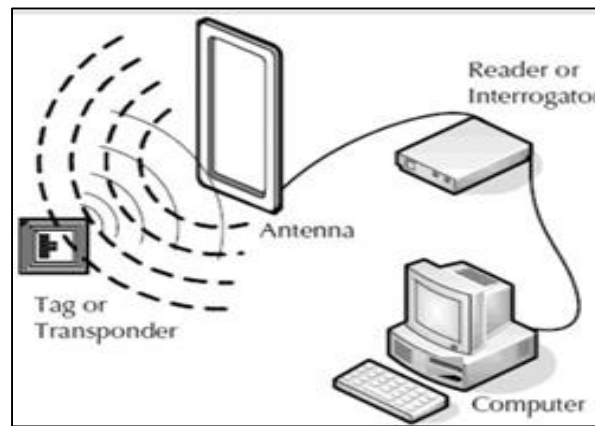


Fig. 1: RFID data transmission and reception

- RFID middleware: It is a computer program that controls one or more RFID Interrogators and allows the data captured by those devices to be routed to another system. RFID middleware solutions provide messaging, routing, and connectivity features required to integrate RFID data into existing library management system.

#### C. IR Sensor (Infrared Sensor)

An infrared sensor is a type of photoelectric beam system used as an electronic alarm. It is designed to alert the user to an intruder's presence by transmitting infrared light beams across an area, where these beams may be obstructed. All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation is not visible to the human eye because it radiates at infrared wave lengths, but it can be detected by electronic devices designed for such a purpose. Infrared radiation enters through the front of the sensors, known as the 'sensor face'. At the core of an IR sensor is a solid state sensor or set of sensors, made from pyroelectric materials-materials which generate energy when exposed to heat. Typically, the sensors are approximately ¼ inch square (40 mm<sup>2</sup>) and take the form of a thin film. Materials commonly used in IR sensor include gallium nitride (GaN), caesium nitrate (CsNO<sub>3</sub>).The sensor is often manufactured as part of an integrated circuit.

#### D. Arduino

The Arduino UNO is a widely used open-source microcontroller board based on the ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board features 14 Digital pins and 6 Analog pins. It is programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share- Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform. The ATmega328 on the Arduino Uno comes pre-programmed with a boot loader that allows to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. The Uno also differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. The Arduino UNO is generally considered the most user-friendly and popular board, with boards being sold worldwide for less than 5\$.

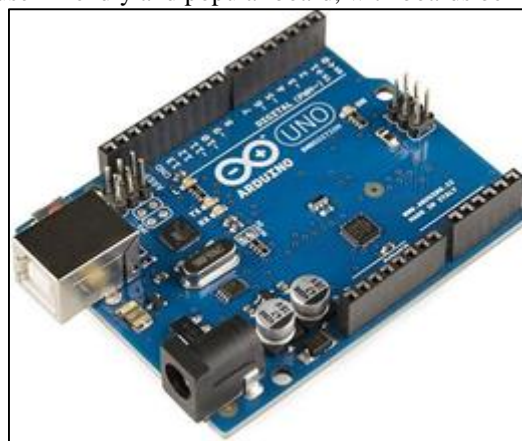


Fig. 2: Arduino Uno board

## II. PROBLEM DESCRIPTION

- Problems in library management
- Membership management
- Security
- Misuse of electricity
- Selection of the library material
- Fee collection

### Goal of the work

- This system is the Fastest, easiest, most efficient way manage library materials with low cost compared. It also includes the functioning of the library environment in a smart and efficient fashion with enhanced part in the connectivity of the readers to the system that allows the user to control and access the entire library from one location.
- The main goal of this system is to overcome the issues like
  - 1) Reducing manual work.
  - 2) Reducing the time wasted in queue
  - 3) Reducing the unnecessary usage of energy.
  - 4) Improve the security facilities in library.

## III. IMPLEMENTATION

The processes like smart card identification using RFID reader, automatic opening and closing of the entrance and automatic energization of the devices like fan, light are included in implementation. Arduino is the technology which is widely used for the efficient automation with low cost. It is a developed microcontroller structure which acts as a open source computer hardware and software. The Arduino Uno board is equipped with sets of digital and analog input and output pins that may be interfaced to various expansion boards and other circuits. Radio frequency identification reader (RFID reader) is used to gather information from an RFID tag which is used to track individual details. Radio waves are used to transfer data from the tag to the reader. Infrared sensor is used to sense certain characteristics of its surroundings by either emitting or detecting infrared radiation. IR sensors capable of measuring the heat being emitted from the body of the person who enters in the computer section in the library and detecting the motion of the people. The library support WEP and WPA2 personal encryption but not WPA2 enterprise. Arduino communicates with the Wi-Fi shield using the SPI bus. Arduino Wi-Fi shield allows an Arduino board to connect to the internet using the Wi-Fi and to read and write. The automatic energization of library become more faster and efficient when the connections become wireless. The input and output port of the Arduino board can be chosen according to the user's requirement. Relays are switches that open and close circuit electromechanically or electronically.

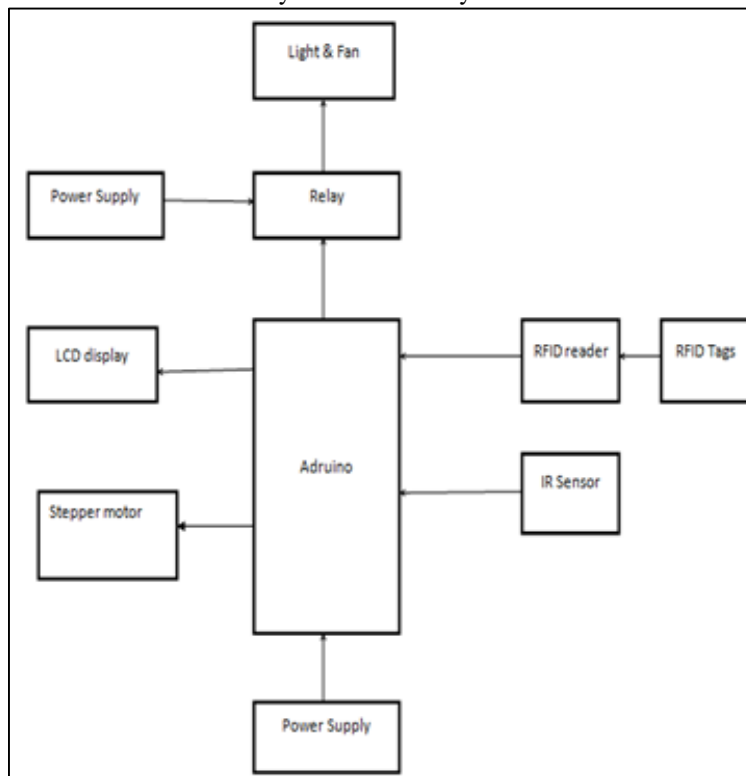


Fig. 3: Block Diagram

Each student in every department is provided with a smart card including their names, department name, and year of study. The time which the students enters the library and coming out of the library is automatically registered when the card is swiped on the RFID reader. The smart card also acts as a security for the library because the entrance of the library opens only if the card is swiped by the authorized student or staff members. Wi-Fi module connected in the library is used to store the data's of the student to the storage computer in the library. When the student enters to the browsing section of the library, IR sensors detects the heat emitted from the body of the particular person which leads to the automatic energization of the electronic devices such as lights, fans and the system where the student sits.

Finally, when the student leaves the particular seat, the IR sensor is again detects the movement of the person and automatically switch off the turned on devices. Internet of things is used as a basic technology for arduino board. The inputs and outputs are taken from the arduino board. The particular inputs in this project are infrared sensors, radio frequency identification reader and Wi-Fi module. The output port includes the relays, storage computer, and stepper motor for entrance. The librarian can Access the data's of the student from any corner of the campus by adjusting the range of Wi-Fi module.

#### IV. RESULTS

The process of registering the details of the person is accessed in the library system, through RFID is based on the technology of Internet of Things. A web application is created with Internet of Things which includes the details of the person.



Fig. 4: The student details are stored in web application

The entrance opening and closing is along with the swiping of the smart card. The turn on and turn off of the lights and fan is detected with the help of sensors. A small amount of work was carried out with this path of success the future work contributes in developing the entire module for our library and integrating the individual systems of module to form the master system with the advantage of cost wise and efficiency, for getting the required book with no search of time that too with no ordered arrangements with manual work reduction.

#### V. CONCLUSION & FUTURE PLAN

The issues & problems faced in the library were identified and the system is designed to promote an easy access for a Librarian to maintain the library The design of the system is carried out based on the ideas to rectify the system with the identified errors as a token of enhancement work. The requirements were pointed out and the study of the requirements was done. The future work contributes in developing the entire module for our library and integrating the individual systems of module to form the master system with the advantage of cost wise and efficiency, with any ordered arrangements with manual work reduction.

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