*Research Article*

# Office Automation using Arduino Nano controlled via an Android application

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### Abstract

*This paper proposes a system that uses Arduino nano along with RFID sensors to store and manage attendance of employees as well as other sensors like DHT11 that are used to collect real-time data such as the humidity and the temperature of a room and stored on a cloud platform and this data can be monitored remotely. It mainly focuses on controlling the devices in an office environment like lights, fans, air-conditioners as well as keeping track of the attendance of the employees. The system is supported by an easy to use android app whose user-friendly interface allows the admin to easily keep track of the live status of devices as well as the attendance of the employees. The key difference between the existing available system and proposed system are – easy installation, low cost, easy to use interface, good user experience.*

## 1. Introduction

The use of mobile phones has increased manifold over the past few decades. With the advent of smart phone technology, smart phones have become an irreplaceable part of human lives across the world. Be it buying grocery or buying clothes online, from ordering food to ordering various services everything is done with the click of a button using the app on the smart phones. It is the ease of doing tasks that this technology offers that has led to its deep penetration even in remote areas of the world and this has eventually forced us to research for more such technologies to make human lives better, thereby building an entire ecosystem of inter-related technologies consisting of – the Internet, smart phones, everyday devices like smart TVs, fridge, washing machine and much more. One such technology is Internet of Things (IoT). IoT is one of the fastest growing technologies that is gaining a lot of momentum around the globe. We have now moved on from having Internet of people, where people used internet as a medium to communicate with each other to Internet of Things, where every day devices are connected to each other and also communicate via the internet and share each other's information just like people on the internet would do and also, such information can be stored on cloud and monitored remotely.

IoT plays an important role in today's fast paced world where getting things done without the need for human intervention has become the need of the hour for improving productivity and paves the way for better utilization of the available resources. Automation plays an important role in our lives. It makes the work easier and simpler so for simplified and easy living, this paper introduces the concept of Office Automation. This paper proposes a system that uses Arduino nano along with sensors that are used to collect real-time data such as the humidity and the temperature of a room and stored on a cloud platform and this data can be monitored remotely. It mainly focuses on controlling the devices in an office environment like lights, fans, air-conditioners as well as keeping track of the attendance of the employees.

The system is supported by an easy to use Android app whose user-friendly interface allows the admin to easily keep track of the live status of devices as well as the attendance of the employees. The key difference between the existing available system and proposed system are easy installation, low cost, easy to use interface, good user experience.

## 2. Objectives

*2.1 To implement Office automation system and monitor it remotely.*
*2.2 Control the everyday devices as well as manage attendance using smart phone.*
*2.3 Provide clean UI to user for good user experience.*

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*2.4 Saving power*

*2.1 To implement Office automation system and monitor it remotely*

Smart phones combined together with Wi-fi technology, the internet and cloud storage platforms (such as ThingSpeak.com) allows us to design and implement a system that can be controlled remotely at ease of your finger-tips.

*2.2 Control the everyday devices as well as manage attendance using smart phone*

The availability of smart phone makes the use of this system less costly since a mobile application can be integrated with the system that can be installed on smart phone and used to control lights, fans, ACs and allows the admin/supervisor to keep track of the attendance of employees.

*2.3 Provide clean UI to user for a good user experience*

The android application provides a graph interface for temperature and humidity which in-turn makes the UI readable even for a naïve user and provides separate login for admin and employees where employees could only control the devices whereas the admin can control the devices as well as monitor attendance.

*2.4 Saving power*

Since the devices can be controlled remotely and also the status of the devices is available in real-time, it allows us to save power by switching off these devices when not in use. Therefore, enabling us to take a step forward towards a greener planet.

## 3. Scope

This paper aims at developing a prototype for Office Automation by using Arduino Nano and RFID system that can be controlled using an android application that will be installed on the user/admin's smart phone and also the live status of the devices will be available to the user. This system of controlling the set-up with smart phone works with the help of REST API provided by the cloud platform (Thingspeak.com) in our case. Thus, a system having all the above features can be used in the following areas:

1) The system can be used for household
2) The system can be used for commercial purposes
3) The system has a low set-up cost, can be installed easily
4) It can help to monitor whether the devices are ON/OFF and thus can help to save electricity, which enables us to become more eco-friendly
5) Implementing such a system does not require any special training for the users, since the android app

provides a user-friendly interface so that the user can handle the system with ease.

## 4. Concept Review

*4.1 Existing System*

In this age of technology, human lives are simplified by a number of technologies around us that have changed the way of our doing things completely by automating them. Thus, requiring minimal to no human intervention, which ensures that the task is completed irrespective of whether the person is present or no. In our case of office premises, traditional approach uses human intervention that is if a person wants to switch on lights, fans, ACs, etc. will have to do so directly by accessing the switch board. While this seemed to be a feasible option until now but what if the person is physically challenged or cannot do so due to illness or some other reason. Then, such a system could not be an ideal one. Also, such a traditional system does not allow to measure other parameters such as the temperature of the room, humidity, etc. Also, attendance of employees cannot be monitored remotely. All such drawbacks of the current system, paves the way for automation that overcomes these demerits of the traditional system. The proposed system is discussed at length in the subsequent sub-topics in this paper.
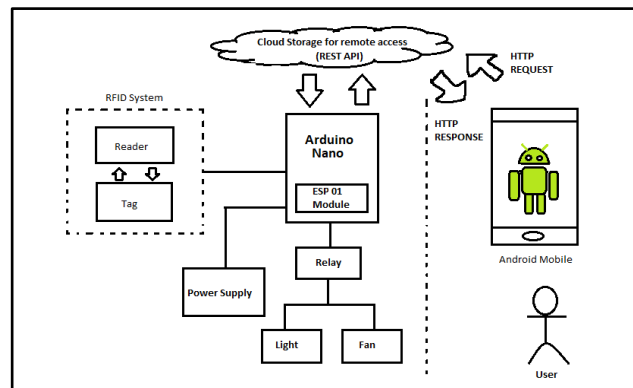
*4.2 Proposed System*



**Fig.1** Block Diagram of the proposed system

This paper proposes a system that uses Arduino nano along with RFID sensors to store and manage attendance of employees as well as other sensors like DHT11 that are used to collect real-time data such as the humidity and the temperature of a room and stored on a cloud platform and this data can be monitored remotely. The RFID tags used are passive tags. It mainly focuses on controlling the devices in an office environment like lights, fans, air-conditioners as well as keeping track of the attendance of the employees.

The system is supported by an easy to use android app whose user-friendly interface allows the admin to easily keep track of the live status of devices as well as

the attendance of the employees. The key difference between the existing available system and proposed system are – easy installation, low cost, easy to use interface, good user experience. The proposed system consists of following important modules:

- Arduino Nano
- ESP01
- Relay
- RFID System consisting of Reader and Tag
- Cloud Platform for remote access (ThingSpeak.com is a free platform that has been used for demo)
- Android application

## 5. Description of Modules

### 5.1 Hardware Modules

The hardware modules consist of the following:
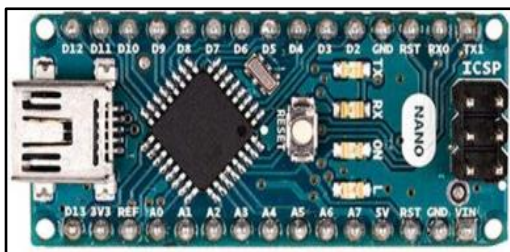
### 5.1.1 Arduino Nano



**Fig.2** Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P (Arduino Nano 3.x).

**Specifications:**

Microcontroller : ATmega328
Architecture : AVR
Flash Memory : 32 KB of which 2 KB is used by bootloader
SRAM : 2 KB
Clock speed : 16 MHz
Analog IN pins : 8
EPROM : 1 KB
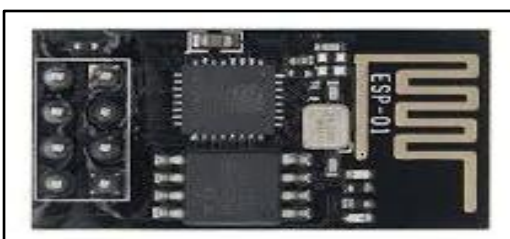Digital I/O pins : 22 (6 of which are PWM)

### 5.1.2 ESP01



**Fig.3** ESP01 Module

ESP-01 is a Wi-Fi module. It allows microcontrollers to access the internet. Using Wi-Fi module in our system allows us to store and retrieve data from the IoT platform. This functionality allows to control the system remotely.

### 5.1.3 Relay



**Fig.4** Two channel relay

A 5V 2-channel relay was used. It can be controlled directly by using micro-controllers such as the Arduino nano. It uses a low-level triggered signal to control the relay, usually ranging from 3.3 - 5V DC. Normally open type of connection was used for triggering the relay.

### 5.1.4 RFID System



**Fig.5** RFID system – Reader & Tag

Radio frequency Identification (RFID) is a wireless identification technology that uses radio waves to identify the presence of RFID tags.

RFID technology is used for identification of people, object etc. presence.

### Reader

It is used to read unique ID from RFID tags. Whenever RFID tags comes in range, RFID reader reads its unique ID and transmits it serially to the microcontroller. RFID reader has transceiver and an antenna mounted on it.

**RFID Tag**

RFID tag includes microchip with radio antenna mounted on substrate which carries 12 Byte unique Identification number.

*5.2 Software Modules & IDEs*

The following free and open-source software were used:

*5.2.1 Cloud Platform*



**Fig.6** ThingSpeak Cloud Platform

ThingSpeak.com is an open IOT platform that provides cloud storage facilities for IoT devices. It provides API for storing and retrieving data using the HTTP protocol. It provides free access for educational purposes and paid subscription for commercial purposes. Our prototype uses the free subscription for demo purposes.

*5.2.2 Arduino IDE*



**Fig.7** Arduino IDE

Arduino Software (IDE) is an open-source software. It is a tool that enable us to write code and upload it to the Arduino board without any hassle. It can run on Windows, Mac OS, etc. It also provides a serial monitor that allows us to see output on the screen or read any error messages.
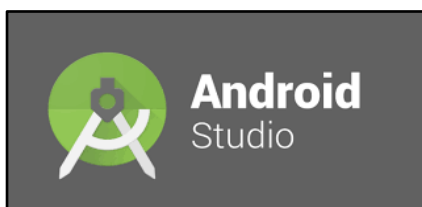
*5.2.3 Android Studio*



**Fig.8** Android Studio IDE

Android studio is the official IDE for development of android applications developed by Google, JetBrains. It allows developers to develop android applications quickly. It can be installed on Windows as well Mac OS systems. One of the most important features of this IDE is that it is an open-source software that enables to keep the cost of the system low.
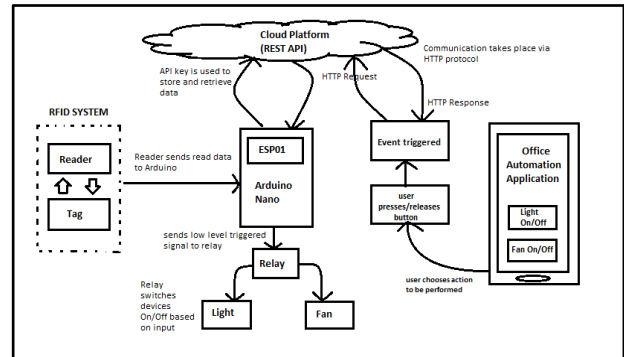
## 6. Working



**Fig.9** Working of the system

- The user has access to the system via an android application
- The user interface provides buttons that can be used to turn lights/fans ON/OFF. As soon as, the user performs some action.
- This triggered event is sent via HTTP request to the Arduino board which in turn executes the corresponding code and sends appropriate response back via HTTP Response and also sends a low-level trigger signal to relay that sends control signal to the device to be controlled. And in this way the device is turned ON/OFF.
- Meanwhile, RFID Reader continuously keeps reading tags in its range and sends this information to the Arduino board.
- This data is then stored on the cloud platform with the help of ESP01 module that enables connectivity to the internet. This enables the user to control the system remotely.

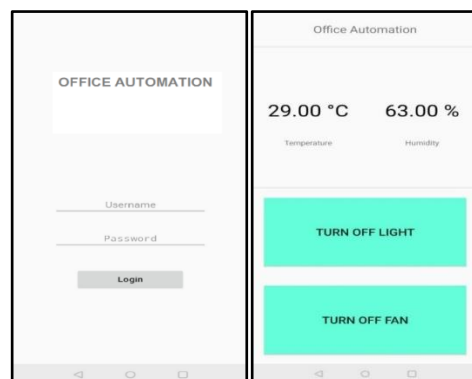The following screenshots show how the Android application UI looks like:



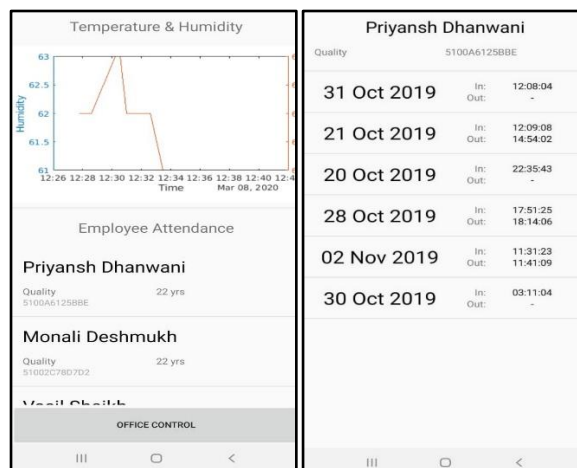**Fig.10** Android app login    **Fig.11** control buttons

**Fig.12** Graphical UI     **Fig. 13** Attendance record

## Conclusion

With this paper we aimed at developing a prototype for Office Automation by using Arduino Nano and RFID system that can be controlled using an android application that will be installed on the user/admin's smart phone and also the live status of the devices will be available to the user. This system of controlling the set-up with smart phone works with the help of REST API provided by the cloud platform.

The proposed system offers some key features that are – easy installation, low cost, easy to use interface, good user experience.

## Future Scope

- The system can be scaled to control multiple rooms in office premises simultaneously and the additional changes can be made easily to the system.
- Also, the attendance management part of the proposed system can be integrated with other modules/systems such as the employee payroll system where the salary can be calculated directly by counting the number of days the employee was present.

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