Iot Enabled Smart Class Room: A Step towards Supporting Digital India

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Abstract: - The prime objective of this research is to develop a smart classroom by the use of Qtouch sensors and RFID technology. Usually, this manual process of the classroom activities is done by manually, and consumes more time and also requires a huge man power. This method of taking manual attendance can be enabled on a digital platform by the use of Qtouch sensors. We are using RFID card to get access inside the smart classroom, so that better discipline and enhanced reliability can be ensured and late comers will not be allowed to enter inside the classroom. The microcontroller also supports other essential features in this smart class such as automatic white board cleaner, automatic control of room's illumination by the proximity sensors and regulation of classroom temperature using the temperature sensors, like DHT-11. The power supply for the working of the smart classroom can be provided by inverter/solar panels the whole processing is done by the use of SAMD21 microcontroller and ATMEL Studio 7.0.

Keywords: Smart classroom, Qtouch sensor, RFID technology, Proximity sensor, DHT-11 sensors, SAMD21 microcontroller, ATMEL Studio7.0

1. Introduction

Nowadays all the information's are easily available on internet thus the students are less motivated to attend the lectures in college [1]. This project is to simplify the task of attendance recording by the use of the Qtouch sensors and also using RFID technology to ensure strictness among the students.

So it is very essential to put an effort to stop bunking of the lectures by the students and also to inculcate regularity and discipline in the college [6]. Moreover this attendance system saves time and avoids registration of fake attendance by the students [2].In case of analyzing attendance the lecturer also has to perform manual computation to obtain the students' attendance percentage, which usually consumes a lot of time and distracts them from teaching and getting full attention from the students [5].

Having said the limitations imposed by the conventional attendance system, we propose a solution in the form of Qtouch sensors which will be placed in the respective chair of a particular student. The main idea behind the system is to capture student attendance in a automated way where the students are required to flash their student card at the RFID reader to get access inside the classroom and take their respective seats. The time period will be calculated for the amount of time they are seated in their seats and graph will be plotted accordingly. This data will be saved and sent to the attendance department through the main server.

2. System Design

A variety of technologies are already available for the purpose of attendance registration. Those are Finger print recognition, Face recognition, Biometric hand reader, RFID cards. But we are using different technology for the purpose of student monitoring and attendance registration with the help of Qtouch sensor and RFID card is used for getting access inside the classroom. Given below is the block diagram of the proposed system.
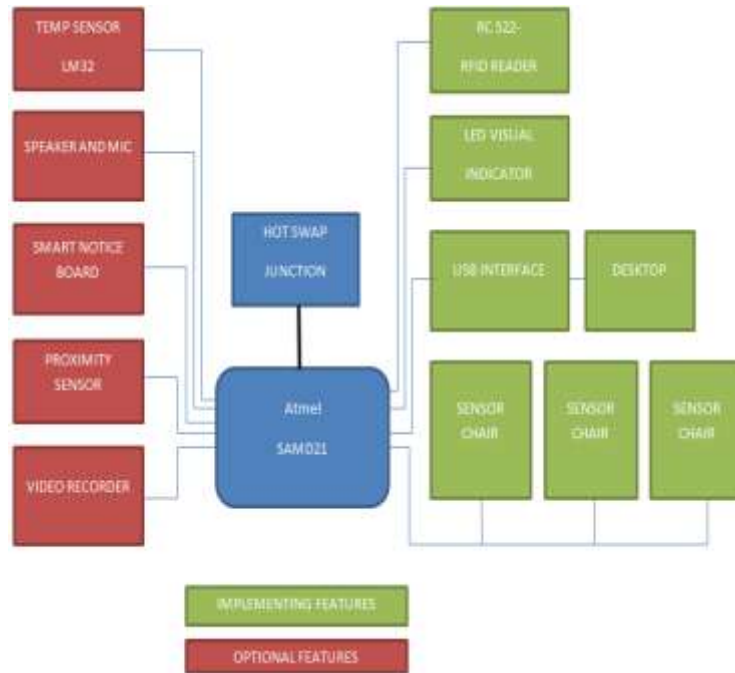
Figure 1: block diagram of IoT enable smart class room

3. Components description

A. QTouch Sensor

The Qtouch sensors are placed on the chairs. These devices are charging a sense electrode of unknown capacitance to a known potential. The electrode is a copper area on a printed circuit board. The charge is transferred into a measurement circuit. The capacitance of the sense plate can be determined by measuring the charge after one or more charge and-transfer cycles .When we place a finger on the touch surface it introduces external capacitance which affects the charge flowing at that point. This is registered as a touch. Qtouch microcontrollers can also be used to detect the proximity of a finger, rather than an absolute touch.
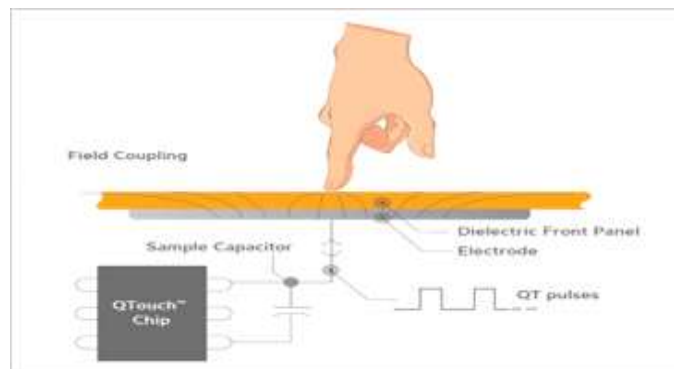

Figure 2: touch mechanism

QTouch technology is basically deployed in two ways, normal mode or touch mode and high-sensitivity or proximity mode. The high sensitive charge transfer proximity sensing. It is used for detecting an end-user's approaching finger, and the user interface interrupt the electronic equipment.

When several touch keys are placed close together, an approaching finger can causes a change in the capacitance around more than one key. Quantum's patented adjacent key suppression AKS makes use of an iterative technique to repeatedly measure the change in the capacitance on each key, then it compares the results and determines which key the user intended to touch. AKS™ then ignores any kind of signals from allother keys, thus ensuring that the signal from the selected key remains above the threshold value. With this false touch detections can be prevented on adjacent keys. AKS is selected by the system designer.

B. Microcontroller (SAMD21)

Atmel SMART SAM D21 is a series of low-power microcontrollers that uses the 32-bit ARM Cortex -M0+ processor. Pin ranges from 32 to 64 pins with 256KB Flash and 32KB of SRAM. SAM D21 devices operate at a maximum frequency of 48MHz and can reach up to 2.46 CoreMark/MHz. The design are basically to support simple and intuitive migration with identical peripheral modules, hex compatible code withidentical linear address map and along with pin compatible migration.

1. Processor

It contains ARM Cortex-M0+ CPU running at maximum of 48MHz, Single cycle hardware multiplier and Micro Trace Buffer.

2. Memory

Memory consists of 32/64/128/256KB in system self-programmable Flash 4/8/16/32KB SRAM Memory.

3. System

Two important pins are Power on reset (POR) and brown out detection (BOD), internal and external clock options with a frequency of 48MHz, and Fractional Digital Phase Locked Loop (FDPLL96M), External Interrupt Controller(EIC) and 16 external   interrupts.
Along with one non maskable interrupt, 2 pin Serial Wire Debug (SWD) programming, test and debugging interface.

4. Low Power

It operates on few modes such as idle, standby, backup and off sleep modes. Battery back up support and embedded Buck/LDO regulator supporting on the fly selection.

C. RFID Technology

RFID stands for Radio frequency identification whichmakes use ofelectromagnetic fields to automatically identify and track tags which are attached to objects. These tags contain electronically stored information.

There are two type of tags Active and Passive. In case of passive tags it collects energy from a nearby RFID reader's interrogating radio waves. Meanwhile active tags have a local power source such as a battery and can operate at 100m distance from the RFID reader [5]. Unlike a barcode, it's not necessarytag need not be within the line of sight of the reader, so it can be embedded in the tracked object. RFID is one of the bestmethod for Automatic Identification and Data Capture (AIDC).
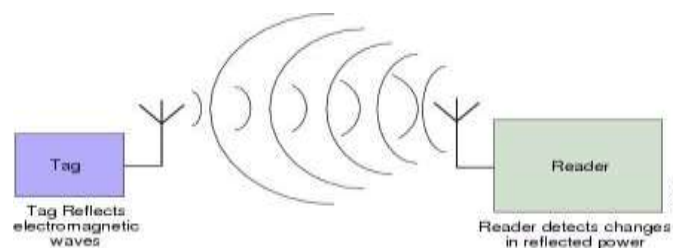
Figure 3: RFID tag and reader

1. Tags

Usually RFID tag has a unique serial number or ID. Basically three types of RFID tags which are most commonly used are active, semi-passive and passive. Active and semi-passive RFID tags require internal battery for operating while, passive RFID tags do not use any kind of batteries [7].

According to our scope of work, the student cards being used for identification of each individual student are the RFID cards consist of passive RFID tag, which does not require internal battery. Now these cards are passed through the field generated by a compatible reader and it transmit information back to the reader.

Most of the RFID tags contains an integrated circuit for modulating and demodulating radio frequency along with an antenna for transmitting and receiving the signals. The Frequency ranges from low frequencies of 125-134 kHz and 140-148.5 kHz, and high frequencies of 850-950 MHz and 2.4-2.5 GHz.

2. Reader

A radio frequency identification reader (RFID reader) is used to gather information from an RFID tag, which is used for tracking individual objects. Radio waves are used for transferring the data from the tag to a particular reader.

RFID readers are basically of two types, which are the active and passive RFID readers. Active RFID reader used to detect an active RFID tag while passive RFID reader used only for detection passive RFID tag which is located at a few centimeters away from the reader. The compulsion is that the RFID tag it must be within the range of an RFID reader, which ranges from 3 to 300 feet, to get the reading. This technology increases the scanning speed and also enables fast identification of a particular product. Moreover it even works perfectly when it is surrounded by several other items.

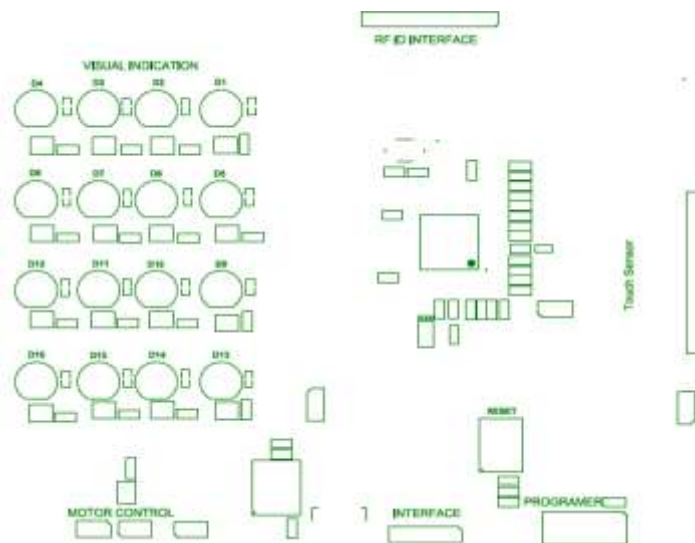**4. Ideology**

A. Schematic Diagram

Figure 4: Visual description

This is a prototype of the actual model of the smart classroom. The RFID interface shown in the prototype will be placed in the door of the actual model. When the tag will be in the range of the reader the door will open to get access inside the classroom.

There is a visual indication of the complete sitting arrangement inside the classroom. The Qtouch sensors will be placed on the chairs.

The sensors and RFID are integrated with the microcontroller and in case of the prototype the power supply to the microcontroller is taken from laptop.

B. Circuit Diagram

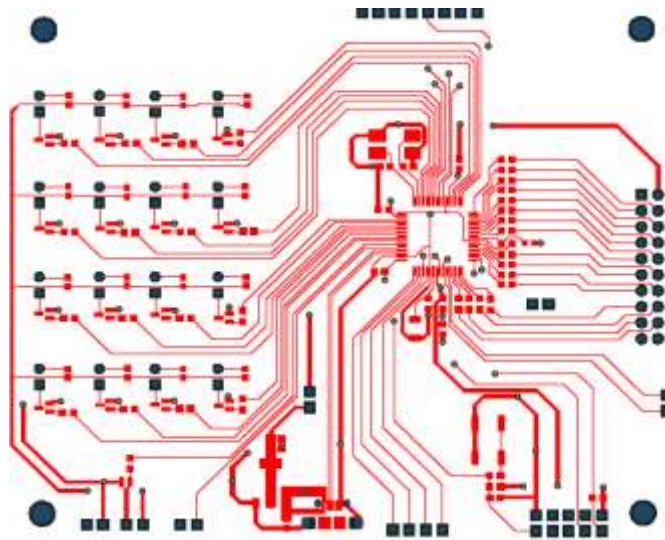The layout of the PCB connection is shown in this diagram.

Figure 5: Circuit diagram

5. Implementation

A. Development board (Hardware)

This is the prototype of our proposed model. Sensor chairs are marked on the chip and when it comes in contact with any human body the LED glows and indicates it's presence. The RFID reader is also integrated with the controller .The power supply for the working of the prototype is taken from laptop.

The sensitivity of the Qtouch controller can be adjusted by coding .The program is provided to the controller through Atmel Ice programmer cum debugger. A regulator is present to convert 5V to 3.3V as the controller can work only at that particular voltage. The whole setup can be visualized by the use Atmel Studio 7.0.
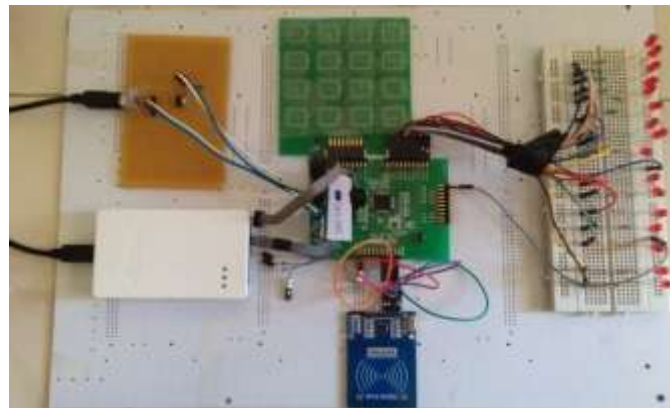

Figure 6: Hardware

B. SOFTWARE

Atmel Studio is basically an Integrated Development Environment (IDE) used for the purpose of writing and debugging Atmel AVR and Atmel SAM applications in Windows environment. Atmel Studio consists of a project management tool, source file editor, simulator, and assembler. The front-end is used for C/C++ programming, emulation and on-chip debugging. Atmel Studio version 6.2 or the latest version that we are using i.e. Atmel 7.0 must be used in conjunction with the Atmel-ICE. It has a modular architecture, which basically allows more interactive kind of environment with the 3rd party software vendors. The other kind of modules such as GUI plugins can be written and hooked to the system.

In this particular project the programming is done in embedded C language. The platform we are using for the coding is Atmel Studio 7.0. It is a free development software that is easily available a in Atmel website. Given below is how the output will be displayed in the monitor. Few steps are required to be followed:

- After opening the Atmel Studio software click on the QTouch Analyser from atmel studio.Then the the program is compiled .
- Now after the program is being uploaded to the micro controller a Pop up window will appear on the screen. This pop up window displays that the kit is not yet connected with the Atmel ice programmer cum debugger. And thus there won't be any kind of graphical display.
- Now as the class is empty the authorized person will select start reading button in the system .Now the sensors will be in working condition. All the information about a particular sensor will be displayed in a tabular format.
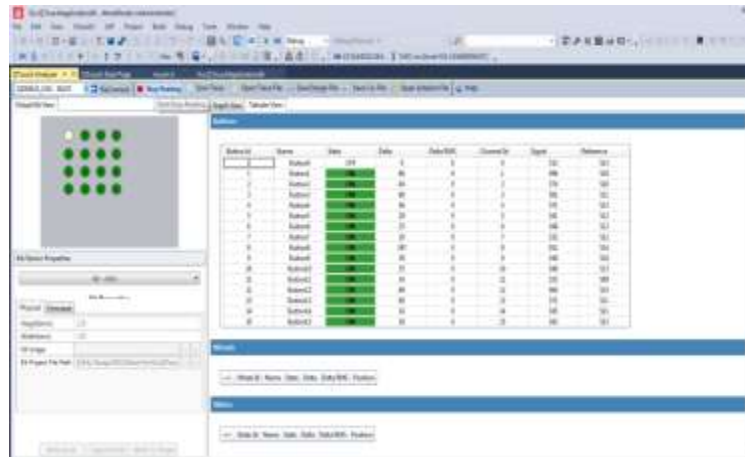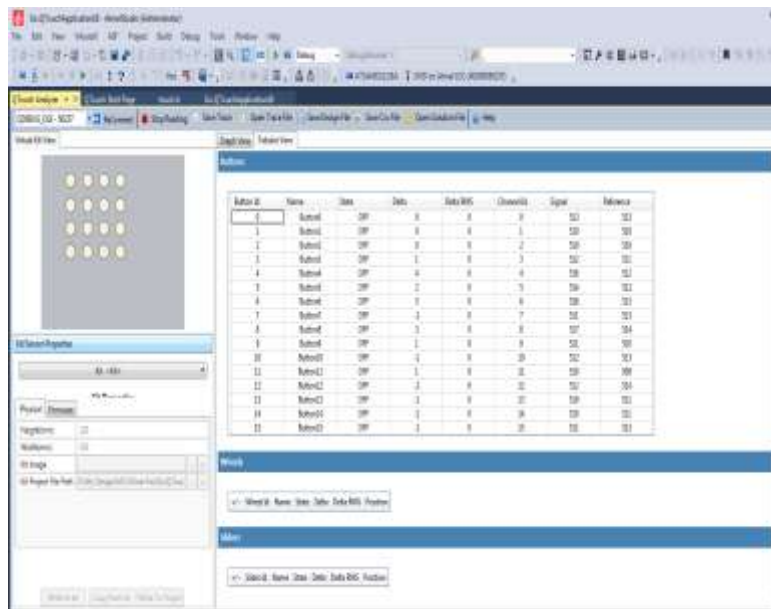

Figure 7: Empty class

- Now when all the students in the class are present .All the sensors will be in active mode. When the class is completed the staff member will click on stop reading .And the complete data of the student will be stored.

Figure 8: full class

- The stored information will be saved .Select save csv for logging the data. Now the particular csv file will be saved in the specified folder and that information will be sent to the attender office through the main server in the college.

6. Graphical Output

Finally the output is obtained in a graphical format. This gives a complete analysis of the student's attendance.

1- Denotes the presence of the student
0- Denotes the absence of the student

The output shows that the class was started at "21:07" and it ended at "21:34". During that period of time the graph shows the students who were present and the student who were absent .It also shows the duration for which the students were attending their classes.
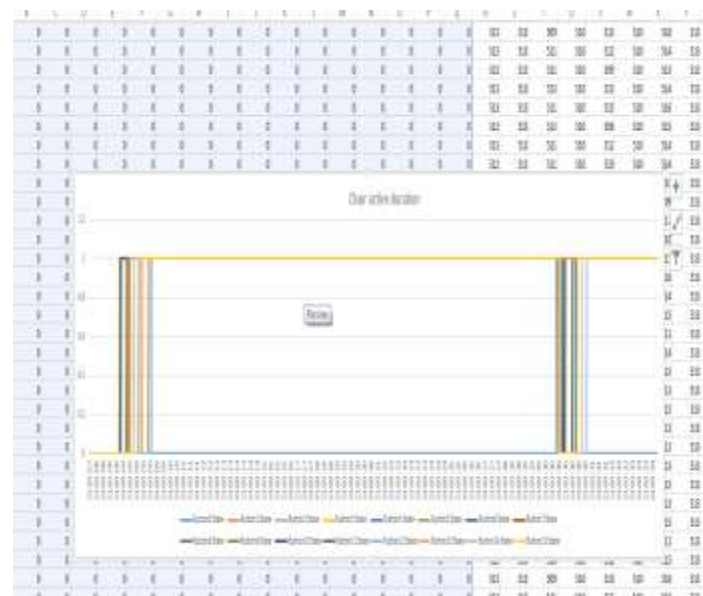

Figure 9: Output graph

7. Conclusions

Having said the limitations imposed by the conventional attendance system, we propose a solution in the form of Qtouch sensors which will be placed in the respective chair of a particular student. The main idea behind the system is to capture student attendance in a automated way where the students are required to flash their student card at the RFID reader to get access inside the classroom and take their respective seats. The time period will be calculated for the amount of time they are seated in their seats and graph will be plotted accordingly. This data will be saved and sent to the attendance department through the main server.

In addition, a number of other advantages are gained by having an system, acting as a central repository of student attendance record. Firstly all processes of managing the student attendance record are performed, allowing administrators and lecturers to view or modify the users' data through any computer via the web browser, as long as they are connected to the Internet. This way, no specific software installation is required. Moreover with this approach there is less risk of data loss, compared to a manual filing approach. Specially the lecturers or teachers will be benefitted the most, as they can easily monitor their students' attendance online and this could improve the quality of teaching since less time is needed to manage the student attendance record. This system can be improved and upgraded further, e.g. by extending the system with new features and modules such as automatic LCD display board, implementing temperature sensor and proximity sensor and automatic board wiper.

Moreover this technology is not only to be used in the smart classrooms but it can also be used in the examination halls Smart and intelligent teaching environment, will make students and teachers to access quality of information more quickly, effortless and perfectly. Making the life of teaching staffs and students more easy and convenient, this would result in the transformation from traditional form to next generation teaching methods.

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