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BLE Based Automatic Attendance System using PSoC BLE

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***Abstract* - Bluetooth 4.0 named Bluetooth Low Energy (BLE) has low-powered Bluetooth devices. Bluetooth is one of the most widely used wireless technology including large number of mobile phones and other portable devices. This technology is used with IoT (Internet of Things) gives us multiple options for various applications, one of which is education and, attendance system is integral part of education system. The conventional attendance system has so many difficulties. In 'BLE Based Attendance System' project, when students walk into classroom with turned on Bluetooth and enter into classroom, attendance is directly registered on system automatically. This can be achieved as; when teacher enters in classroom they turn on PSoC to take attendance. The board will scan for available BLE devices in the classroom through registered UUIDs (unique addresses provided to every Bluetooth device) of students phones to their specific names/roll no. In this whole scenario students will have to just turn on the Bluetooth on their phone. After this process the attendance will be uploaded on network host (PC, Server, etc.) for further use. The system will give us output in a log which can be further utilized for calculating total attendance, defaulters, etc. So overall this system provides a secure and user friendly approach to a time consuming system..**

Index Terms: BLE, Bluetooth, UUIDs, IoT, PSoC, Server.

I.INTRODUCTION

Generally attendance is a really difficult task for both students and teachers. The system needs lot of paperwork which is hard to handle and can be altered or misplaced [1]. This project is an attempt to solve the problem of attendance monitoring using a BLE based system. This application reduces the time taken during conventional attendance and human errors.

There are multiple controller based attendance systems to be found on Internet. But they are generally RFID or Biometric based so you need to carry an ID card consisting of magnetic strip and wave it in front of the RFID sensor or stand in front of Biometric sensor [2]. BLE based systems carry BLE tags similar to RFID increasing manufacturing material [3].

These types of systems are generally costly so we wanted to develop a hassle free, easy to use and economical attendance system. Due to wireless network there would there is no need of going to scanner, even though we can set up scanning range for particular are for proper attendance of the class, workspace, etc. The security of system can be further increased by using security features of mobile phones [4].

The system can be easily understood by block diagram provided in Figure 1.

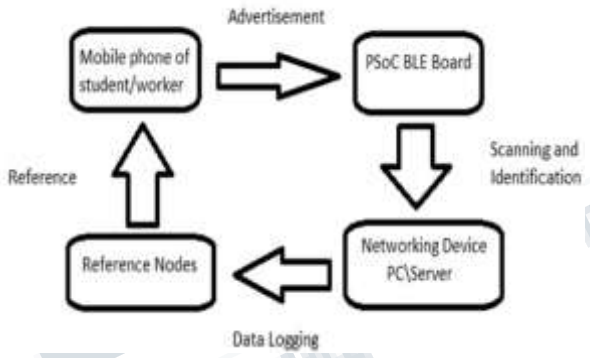

Fig 1: BLE Based Attendance System Block Diagram.

A. Bluetooth Low Energy

BLE is Bluetooth 4.0 also called as Bluetooth smart. The primal reason of BLE is to produce energy efficient smart devices majorly used for IoT purposes. Each BLE device is provided its own 128 bits unique identity number (UUID) which is given by Bluetooth Special Interest Group [5].

The major advantage of BLE is that it can even work with devices with conventional Bluetooth which makes any BLE system versatile in nature. This also reduces cost of any particular application.

The power consumption is reduced by using low power Bluetooth techniques such as Sniff, Hold and Park. Due to which even a PSoC device can work for

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couple of years on a single 3.3v Li-ion battery if programmed for full low power consumption mode [6].

B. BLE Protocol

Every BLE device has two roles to perform while communication. These two profiles are Generic Access Profile (GAP) and Generic Attributes (GATT). With each profile comes device role selection and by its role the services can be programmed or pre-established services can be used.

GAP: Generic access profiles are used to establish and maintain connection between devices. A device can be Central or Peripheral or in rare cases both (not simultaneously). A Peripheral advertises the advertisement package to show its presence, this advertisement package can contain data, address, information, etc. A central device receives the advertisement and decides to either to connect the device or not or to ask some more information.

GATT: Generic Attribute profile contains information of services which give the device its task which it is going to perform (in this case to scan for students devices.) Just like GAP, GATT consists of two device roles Client and Server which mostly contradict with GAP roles i.e. GAP Central is generally GATT client.

A Client can send requests to server to perform attributes and can modify the attributes.

A Server stores and executes the attributes [7].

C. PSoC Pioneer Board

The PSoC board consists of a Baseboard and a BLE device which can be seen in figure 2.

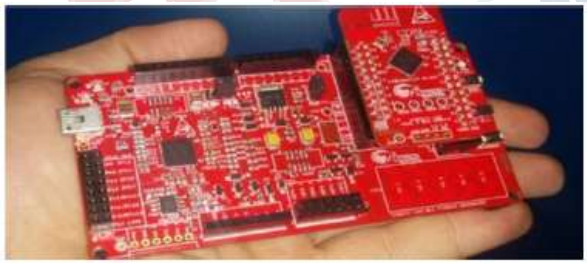

Fig 2: PSoC Pioneer Board [8].

The PSoc BLE Pioneer Board has a PSoC 5 core which is generally used for board applications of controller and USB to UART conversion. Figure 3 shows architecture of Baseboard.

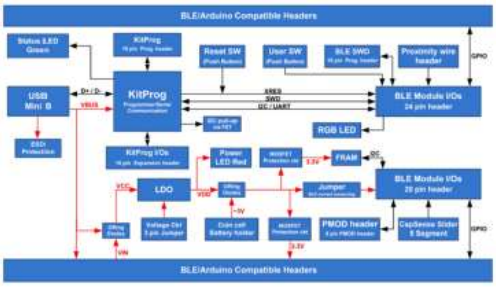

Fig 3: PSoC Pioneer Baseboard Architecture [8].

Whereas main BLE module gives simple access to the new PSoC 4 BLE gadgets, while keeping up the recognizable CY8CKIT-042 PSoC 4 Pioneer Kit plan impression. Architecture of BLE module is given in Figure 4.

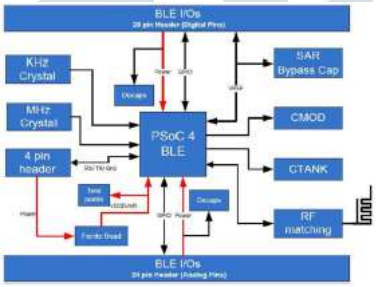

Fig 4: PSoC BLE module Architecture [8].

The Pioneer board even comes with Arduino compatible headers to increase the number of options for peripheral devices [9]. The board is programmed by 'PSoC Creator 3.3 software' which provides two simultaneous ways of designing, the system blocks can be easily assembled using drag and drop method and can be established on board without any issues. Then each of these blocks (subdevices) need to be set up by giving parameters, and at last the system working is provided by main C code.

Fig 5: PSoC creator 3.3 IDE [8].

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In this project PSOC board is acting as GATT client and GAP central as board gets advertisement package and registers the attendance Whereas Mobile phones of student act as GAP Peripheral and GATT Server.

II. WORKING AND FLOWCHART

A. Programming Logic and Flowchart.

Figure 6 explains the programming logic at PSoC device.

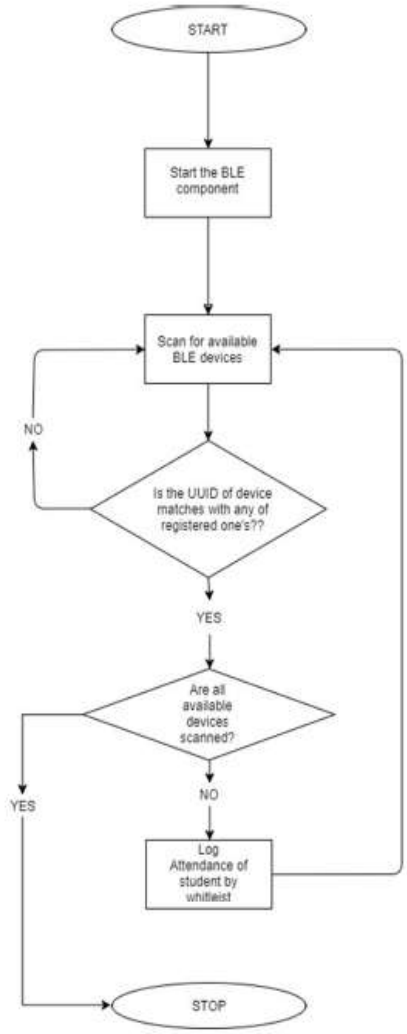

Fig 6: Flowchart of application at PSoC device.

The registration of UUID'S is done at the very starting stage, where each student and their phones UUID'S are stored into a priority memory list known as whitelist which will be used as reference for attendance. The PSoC board scan's the available Bluetooth advertising devices within mentioned area.

Each devices UUID's are seen and checked with Whitelist provided by authority. By checking the available and reference UUID's the system will make attendance as, if a UUID is available and that corresponds to ABC student, then that student will be marked as present. The data will be logged at networking host like PC or Server.

B. Working of the System.

The system will work as when teacher enters in classroom they turn on the board. The students will turn on their Bluetooth application on mobile phone.

The board will scan each and every device in its specified range and log the attendance by logic provided in flowchart Figure 6. This data will be sent to network host where it can be used for multiple purposes. Figure 7 represents flow of information in system in a simple manner.

Fig 7: Information flow in the process.

III. RESULTS.

The system was implemented and used in prototype version. The attendance was registered as expected. The range of PSoC device was altered as per classroom required. The following figure shows results of a prototype on Tera-Term window.

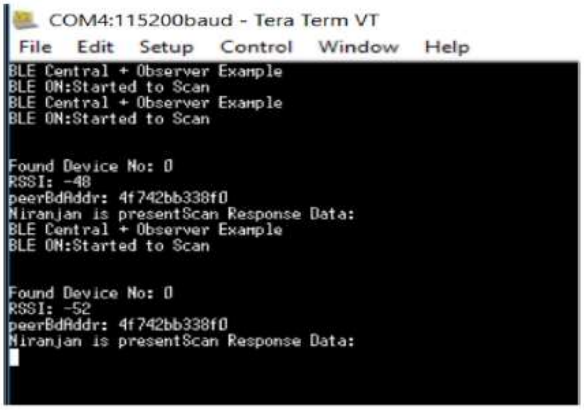

Fig 8: Results.

The system not only detects the student's name but also total number of students, starting from 0.

IV. CONCLUSION.

This paper describes the BLE protocol and its application for use of automatic attendance system. Potential applications: In school, colleges, offices, etc. that may reduce manpower, cost and energy consumed to take attendance. By adding the concept of IoT clouds system can store the attendance on cloud server which later can be utilized.

V. ADVANTAGES AND FUTURE SCOPE.

Advantages:

- Reduction in paperwork and time consumption.
- Conditions such as proxy/unethical attendance can be reduced to minimum by adding and using multiple security features of modern mobile phones such as: fingerprint scanner and face detection.
- Attendance analyzing throughout the campus is made easy and user friendly.
- System can be deduced further for multiple use.

Future Scope:

- Enhancing by sending an email or text message to the students or parents who have attendance below
- a particular percentage.
- Using cloud computing the attendance can be seen at fingertips from anywhere.

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