Low Cost Real-time Room Occupancy Indicating System

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***Abstract*—The objective of this action research based project was to tackle a problem faced by corporate environments. The typical corporate office consists of several meeting rooms with employees requiring frequent access to these meeting rooms, but lack of real-time knowledge of its availability leads to inconvenient hassle. The proposed solution consists of a network of motion detection sensors (namely, the PIR sensor) spread out across all meeting rooms, updating the room occupancy status in real-time to a central base-station, a desktop computer, from which it can be relayed to the employees using a web server or a smartphone application.**

Each sensor node is designed to be Low Cost, Wireless and Low Power for seamless integration and to avoid frequent battery replacement.

I. Introduction

In a typical corporate environment there exists multiple conference/meeting rooms. The site that we studied was at Fractal Analytics, Goregaon. The office has around 400 employees: 250 employees on 7th floor, 150 employees on 3rd floor. 7th floor has 10 meeting rooms and 3rd floor has 5 meeting rooms. Anyone can book any meeting room for any time (if the room is available) using a mobile app. This is an open office - hence if anyone wants to have a discussion then they need to go to a meeting room. Hence meeting rooms are always in demand.

The problem was that anyone could book a meeting room and then not use it. Or if someone wanted to have a meeting without prebooking the meeting room the he/she would have to go from room to room to check the availability of the rooms. The would create a lot of unnecessary hassle and would lead to unoptitmal utilization of the workspace.

To solve these problem we envisioned a solution which would involve placing sensors in every meeting room to monitor the occupancy of the room. This sensor will then relay the real time occupancy information of the room to a central device which will keep track of the occupancy status of all the meeting rooms. This data can then be showed on a web/mobile interface to check the real time occupancy status of the meeting room or the data can be integrated with the the mobile app to automatically book or cancel the meetings as per the occupancy of the rooms.

II. System Design

A. Prototype breadboards

For testing purposes, we have designed the prototype of the circuit on breadboards which included the microcontroller, radio module and an OLED display

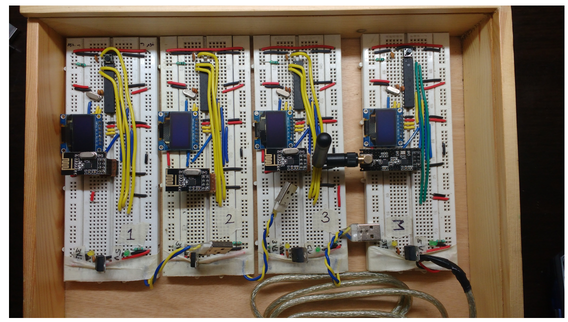

Fig. 1. The 4 breadboard prototypes

B. PCBs

Later we created PCBs using Autodesk Eagle and had it manufactured so that each node is of a small form-factor and is reliable. For this SMD components are used wherever possible. Ports for a Real Time Clock (RTC) is provided for future use in improving the low power capabilities.

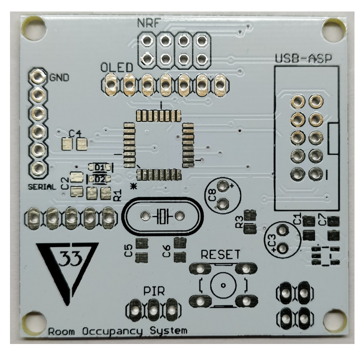

Fig. 2. The PCB created

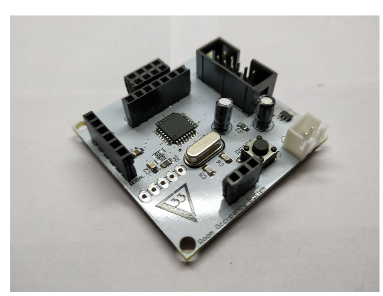

Fig. 3. The PCB assembled

C. Enclosure

The enclosure was designed on Autodesk Fusion 360 and 3D printed for a professional look.

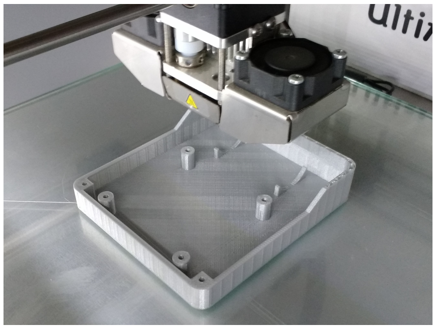

Fig. 4. Node base under print

III. Results

The end result was neat and aesthetically pleasing which gave the sensor nodes a product-like professional look. Real-time room occupancy can be seen on node by node basis on the Web-GUI.

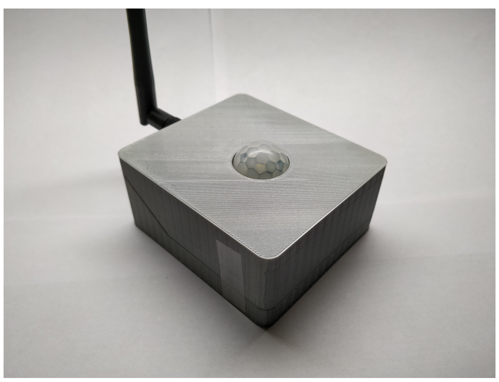

Fig. 5. The Final Outcome

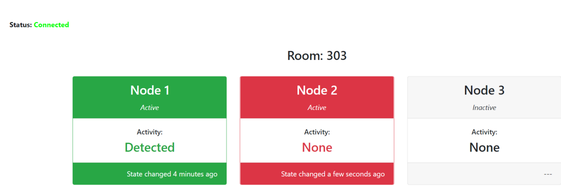

Fig. 6. The Web-GUI

IV. Future Scope

A. Testing with increased number of nodes

Increasing the number of networked devices poses many challenges such as handling the require amount of connections, handling packet losses, planning deep sleep timings, etc and also may create some other unforeseen problems. This has to be tested and our next goal is to run 10 simultaneous devices (which we have available) and go further from there on.

B. Mobile Application

Current demonstration runs off a local server with the client (browser) based on the host machine itself. Since the webserver is based off Flask (Python), deploying it over the internet is easy and only requires some paid subscription for server hosting. After this, the same Web GUI will run on any smartphone browser or can even be integrated into a mobile application.

C. Implementation at Fractal Analytics

Create a set of 10 physical sensors which can be implemented on the 7th floor in Fractal Analytics Create a simple mobile app page - which will show the occupancy status of individual rooms on a smart phone This will give us an invaluable experience of understanding what it takes to implement a project in a real life live environment

V. Conclusion

We were able to create a wireless network of battery operated devices which which would sense the occupancy of each room and then relay the occupancy status to a central master device. The device then relayed the real time occupancy status to a local server. A web browser (client) can then dynamically, using websockets, view the status of each node in real-time. Future scope includes reducing the power consumption of nodes by utilizing microcontroller sleep techniques when the device is not transmitting.

Acknowledgments

We would like to take this opportunity to thank Aashish Nehete for his immense help in creating and designing the web-based GUI for this project. We are also grateful to Prof. Kaiser Katchi for his help in 3D printing the project enclosure. Special thanks to our institute, Sardar Patel Institute of Technology, for providing us with 3D printing services and a platform for us to showcase our project.

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