



## SENIOR DESIGN PROJECT IN ELECTRICAL ENGINEERING

# ENHANCED LOCATION AWARENESS

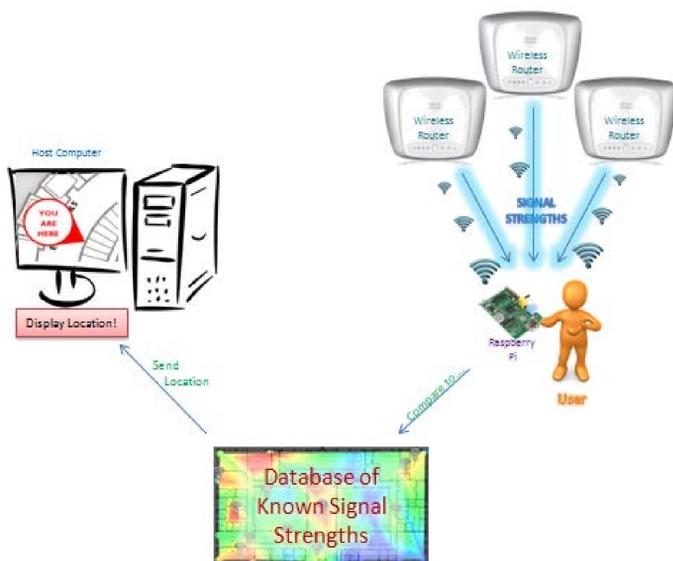
## TRACKING AND POSITIONING VIA LOW POWERED SENSOR DEVICES

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### PROJECT BACKGROUND

In 2013 the USCG finished construction of a new 1.2 million square foot Headquarters building in Washington D.C. Due to requests from those living in the area to not disrupt the local scenery, the building was laid low along the hillside. The design implementation caused a cascading effect on the building which resulted in a very intricate floor plan that can become very confusing to navigate quickly and effectively. This proof of concept project was created in order to begin experimenting with indoor tracking to help facilitate moving personnel around the new facility in an expeditious manner. The method being explored uses wireless access points and the corresponding signal strengths as a resource for locating a person's position. If this project is successful, it will act as a spring board for possible implementation within Coast Guard Headquarters as a means to help personnel and visitors navigating around this complicated building. Success may also open doors for expansion to areas of security and locating personnel.



SOFTWARE ON RASPBERRY PI COMPARES REAL-TIME MEASURED SIGNAL STRENGTHS TO A DATABASE OF KNOWN SIGNAL STRENGTHS TO ESTIMATE, SEND AND DISPLAY LOCATION ON HOST COMPUTER.

### PROJECT REQUIREMENTS

FIVE MAJOR REQUIREMENTS WERE IDENTIFIED FOR THE PROJECT:

- BE A PORTABLE, HANDHELD DEVICE
- INCORPORATE A USER FRIENDLY DISPLAY
- PLOT A USER'S POSITION IN REAL TIME
- HAVE ROOM-TO-ROOM PRECISION
- UTILIZE EXISTING INFRASTRUCTURE AS IS AVAILABLE AT USCG HEADQUARTERS.



COAST GUARD HEADQUARTERS BUILT ALONG A HILLSIDE IN WASHINGTON D.C.

### PROJECT DELIVERABLES

THE PROJECT GOALS ARE:

- CREATE SOFTWARE CAPABLE OF ACCURATELY CALCULATING POSITION WITHIN EE WING OF MCALLISTER HALL
- UTILIZE WIRELESS ACCESS POINTS AND SIGNAL STRENGTHS CURRENTLY IN PLACE AS MAIN TOOL
- TRANSMIT USERS LOCATION FROM HANDHELD DEVICE TO HOST COMPUTER DISPLAY

### METHOD AND RESULTS

The project currently utilizes a method of Fingerprinting along with a Nearest Neighbor algorithm for all calculations. These methods were chosen due to ongoing research currently being explored for indoor tracking purposes. The concepts postulate that with enough routers, the set of signal strengths identified for each location within a building will be unique enough to determine a user's position.

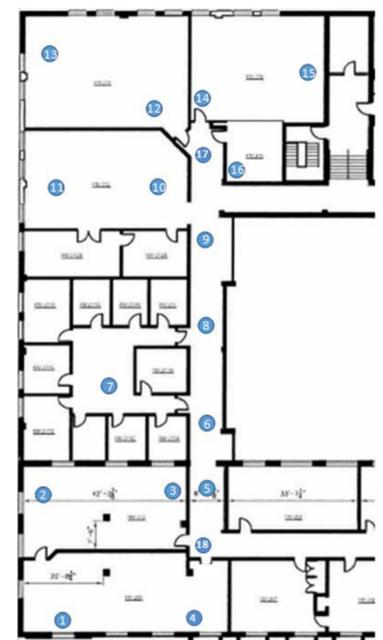
For this project real time data is obtained via the Raspberry Pi from signal strengths of wireless access points within the building. The two methods are implemented through calculations that compare real time measured data to data stored within a database. From here the closest match between the data base and the measured signal strengths is returned as a position number.

Once the position number is returned, it is compared to a stored database and then outputted in the form of a simple GUI that the user can use as a visual reference.

For successful dynamic locating, the real time data of each subsequent position is only compared to the database information of the stored positions in the immediate vicinity. This decreases calculation time and increases accuracy by limiting the locating area of each new position.



A FLOOR PLAN OF MCALLISTER HALL WITH OVERLAY OF WIRELESS ACCESS POINT LOCATIONS AND SIGNAL STRENGTHS CREATED BY NETSPOT APPLICATION.



A FLOOR PLAN OF MCALLISTER HALL WITH NUMBERED POSITIONS CORRESPONDING TO STORED SIGNAL STRENGTH DATA IN THE DATABASE.