# In-door Localization based on Wi-Fi technology

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***Abstract-* We developed a technique that give us the ability to locate or track ourselves in a well-defined building throughout our movements inside that building. We used the Wi-Fi techniques combined with small chip which can be attached to the elder people and some circuit elements. The result can be accessed through the mobile app or the web server, then we can reach the detected man with the chip and give him help if he needs or to make sure of his safety**

## I. INTRODUCTION

There are many organizations that concern about finding the position of people around the world and they use many different methods to achieve that like google that try to map the world into small colored blocks to make you see where you are through the small screen of your mobile app, and the manufacture organizations that help developing the microchips that track us very easily and give information about where we are [5].

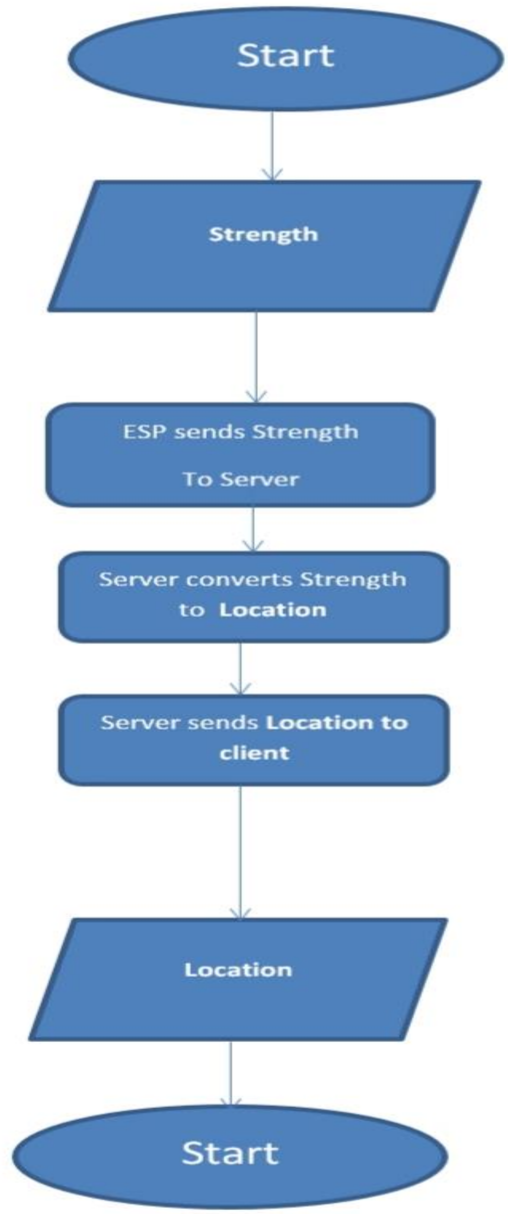
People are facing many problems when they get old as they have physical issues in the gait or balance and sitting also they have mental issues in critical thinking, decision making and recognizing their relatives or friends also they maybe can't recognize where they are and forget where they were going, so they need to be monitored almost all the time and continuously be noted of their location. The problem is in many developing countries they can't afford putting their elderly in old age homes as it will be a high cost for that, also we cannot ensure that we track every one of them where he is or what he doing.

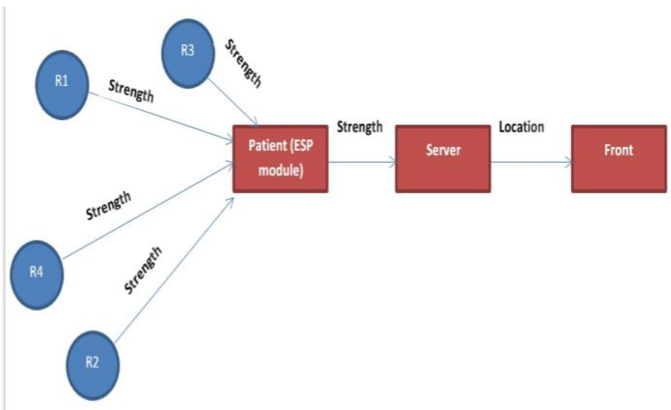
Fortunately, there is a huge progress in the field of wearable devices. The development of multiple wearable sensors and devices can be compensated with the technology of localization to produce a wearable device that can track the elder people in the old age homes or in an Alzheimer sanatorium or in there normal home based on (ESP) microchip that deal with the Wi-Fi rotors in the in-door buildings and it can calculate the strength of the rotors signal and get their (MAC id) and combined with the principle of triangular distances we can figure out where the wearable detector that the elderly wear through a small map of the floor or the building that they live.

However, the progress that happened in this field is almost impossible to have a very good accuracy for this devices as they face some problems, as it should be an excellent and detailed map for the building or the floor and existing of some walls can reduce the signal strength and affect on the measurement. But we try hard to take those challenging problems in our consideration in our approach to get a higher accuracy.

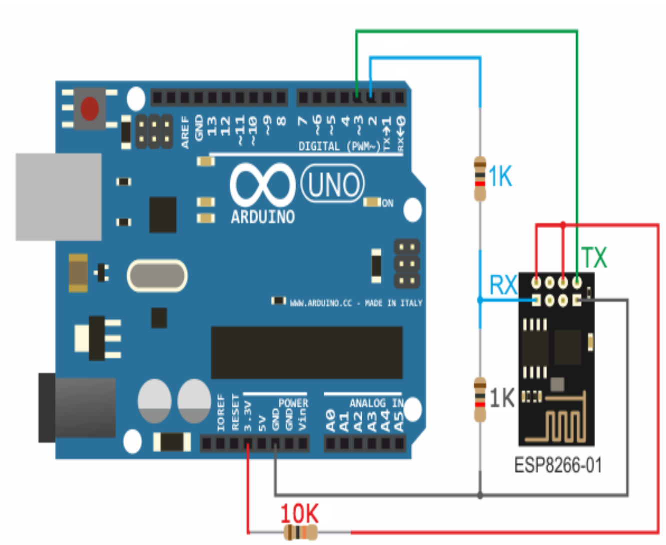
## II. MATERIALS AND METHODS

### *A. Figures*






B. ESP connection and use

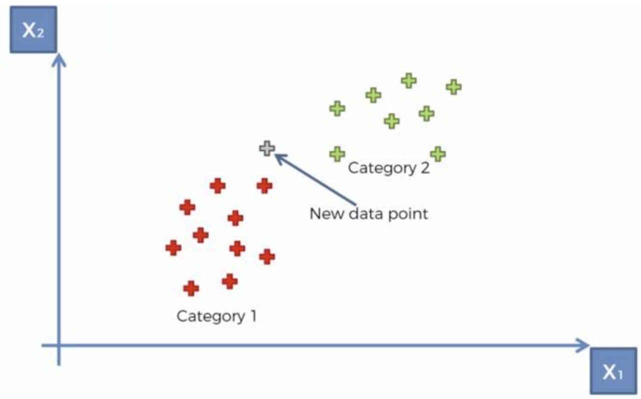



We used the ESP microchip as ESP32 [3] can perform as a complete standalone system or as a slave device to a host MCU, reducing communication stack overhead on the main application processor. ESP32 can interface with other systems to provide Wi-Fi and Bluetooth functionality through its SPI / SDIO or I2C / UART interfaces, so we use it in the project to connect to three in-door Wi-Fi as the ESP [1] can connect to each one and specifically know how much the strength in each of them. ESP powered by using the Arduino to show the data and control its output. Through knowing the strength, we can convert it to a reliable information that tell us the location of the ESP it self through a software algorithm.

## C. Server and backend

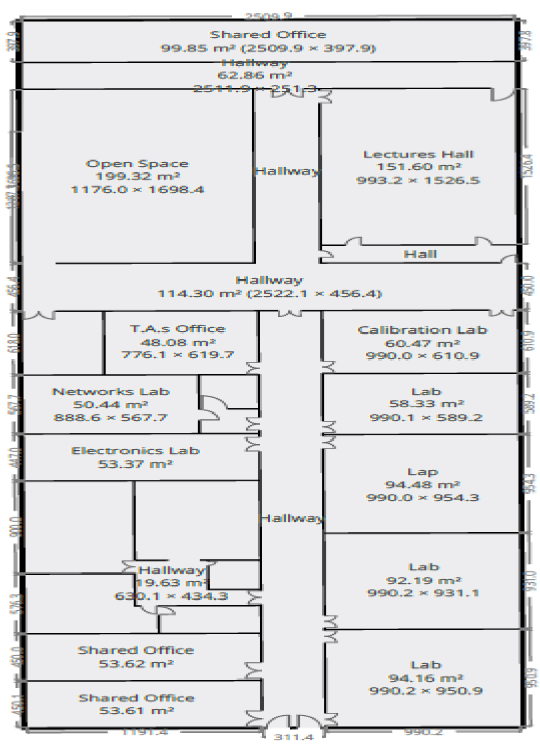
We need our application to be portable to make it usable for the elderly and easy to move with anywhere as result of that we should make the change in the ESP location observable in real time so, we upload the strength data on a server online and then we use a software code in the backend of the server that receive three numbers from the chip on HTTP request and handle their formats to convert the strength of the Wi-Fi connections to a distances between them and the ESP so we can use the modified information and apply on it anther algorism as machine learning model that can convert the distances to a specific location of ESP .

## *D. Machine learning and algorism*




Now [4], we got the data from the backend server as a distances between the Wi-Fi and the ESP then we apply our machine learning model on them, our model is KNN. K-nearest neighbor algorithm is a simple, easy-to-implement supervised machine learning algorithm that can be used to solve both classification and regression problems. So we use that classifier to put the distances into categories using the probabilities and train concept and if we add a new input location (mean that the elderly who is wearing the devices is now in a new location) classify it to a specific location, through that we can know their location.

## *F. Frontend and interfaces*



Our application is used in in-door locations and connect to three different Wi-Fi and know the strength of each one so we used a small floor plan for visualization of the location as a map consist of some known rooms with its borders and the location appears as a point on the map.

After the backend knows which room is the location, it will send its number to the angular frontend that corresponded to X,Y shown on the map regarding all the dimensions to add more detailed information and a point of location appear on the map.

### *G. Proposed System and Related Work*

To make a device that used for old people or for people that suffer from Alzheimer, it should have many features related to the sort of disabilities they have, as the device must be wearable and lite weight, hundred percent safe form the electronics charges or wires so, the device will be presented as a bracelet that anyone can wear and move freely any where among the rooms or the corridors of the floor and be supervised easily through the frontend map.

However we know that we are facing some problems that affect the efficiency and the accuracy, because of existing of walls in the floor the signal that had been sent from the Wi-Fi rotor is reflected and the actual strength not obtained by the ESP also the existing of some metals and concrete affect on the measurement and definitely there are some small errors due to the manufacturing of the electronic components, on the other hand we take all of these into our consideration in our approach.

We worked on adding more features on the bracelet one of them was the feature of fall detection as we provided the bracelet with a led, if the elderly fall, it will be a sudden change in the strength of the Wi-Fi that sent to the backend we tried to trace this sudden change among the data and we can make a sign in the frontend map and also flash the led as an alarm.

We used the led to till the elderly or their supervisors about the status of the connection, if the ESP connected to the Wi-Fi without any problems the led will give us a green light, if there is no connection it will give us a red light and if there is a connection but facing some problems, the led will flash.

## III. RESULTS

The below table may be not clear at first look but we take these samples from the experiments that we do, as the shown numbers represent the strengths of Wi-Fi normalized to zero and the names of rooms that contain a rotor which means that if you are beside the Wi-Fi you will get zero strength that mean strongest place so whenever go far away from the rotor in each room you take a negative values.

Depending on the measurements the output shown as a code of the location of the bracelet as {0: 0.1} represent the location of the lab and {0: 0.2} represent the professors room.

| | |
|---|---|
| STUDBME2: -57, CMP_LAB1: -100, REHAB LAB: -87, {O: 0.1} | STUDBME2": -64, CMP_LAB1" -100, REHAB LAB ": -86, {O: 0.1} |
| "STUDBME2": -60, "CMP_LAB1": -100, "REHAB LAB ": -90, {O: 0.1} | "STUDBME2": -54, "CMP_LAB1": -100, "REHAB LAB ": -87, {O: 0.1} |
| "STUDBME2" -58, "CMP_LAB1": -100, "REHAB LAB" -88, {O: 0.1} | "STUDBME2": -52, "CMP_LAB1": -100, "REHAB LAB ": -85, {O: 0.1} |
| "STUDBME2": -61, "CMP_LAB1" -100, "REHAB LAB ": -86, {O: 0.1} | "STUDBME2": -58, "CMP_LAB1": -86, REHAB LAB: -86, {O: 0.1} |
| "STUDBME2": -74, "CMP_LAB1": -82, "REHAB LAB ": -57, {O :0.2} | "STUDBME2": -70, "CMP_LAB1: -73, "REHAB LAB ": -54, {O :0.2} |
| STUDBME2" -100 "CMP_LAB1": -80, "REHAB LAB": -39, {O :0.2} | "STUDBME2": -73, "CMP_LAB1": -88, "REHAB LAB": -49, {O :0.2} |
| "STUDBME2": -72, "CMP_LAB1": -100, "" REHAB LAB ": -56, {O: 0.2}, | "STUDBME2":-100, "CMP_LAB1":-80, "" REHAB LAB ":-62, {O: 0.2} |

[2] [5] [4] [1] [6] [3]

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