ON-DEMAND ANTENNA POSITIONING SYSTEM

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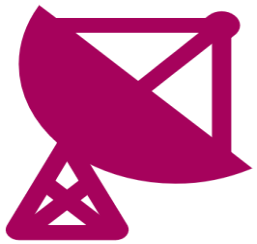
Problem Statement

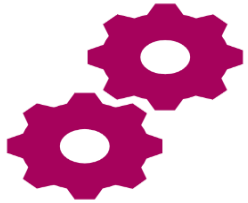
- Companies are more focused on 5G, yet about 95% of customers are still using 4G and below, which have their Antennas supported by RET

- Currently only Vertical tilt is done remotely while azimuth is set once manually and remains fixed making optimization limited.

Objectives



To build a low cost and efficient On-Demand Antenna Positioning System



To develop a clustering machine learning algorithm

To develop a localization algorithm for distance and bearing calculation

To use the developed clustering and localization algorithms, a microcontroller and motor to vary antenna bearing

Justification

Big Tech Companies Spend Billions of dollars on 5G Beam forming research, we can achieve same goal with a smaller investment and currently available local materials

Safaricom can sell our tech to other Telecom companies in East and Central Africa, making even more profift

Efficient network usage for on-site customers, happy customers rate the company highly, hence improved
company net promoter score

Reduced cost by Automation of Antenna Positioning, currently manual costs are incurred

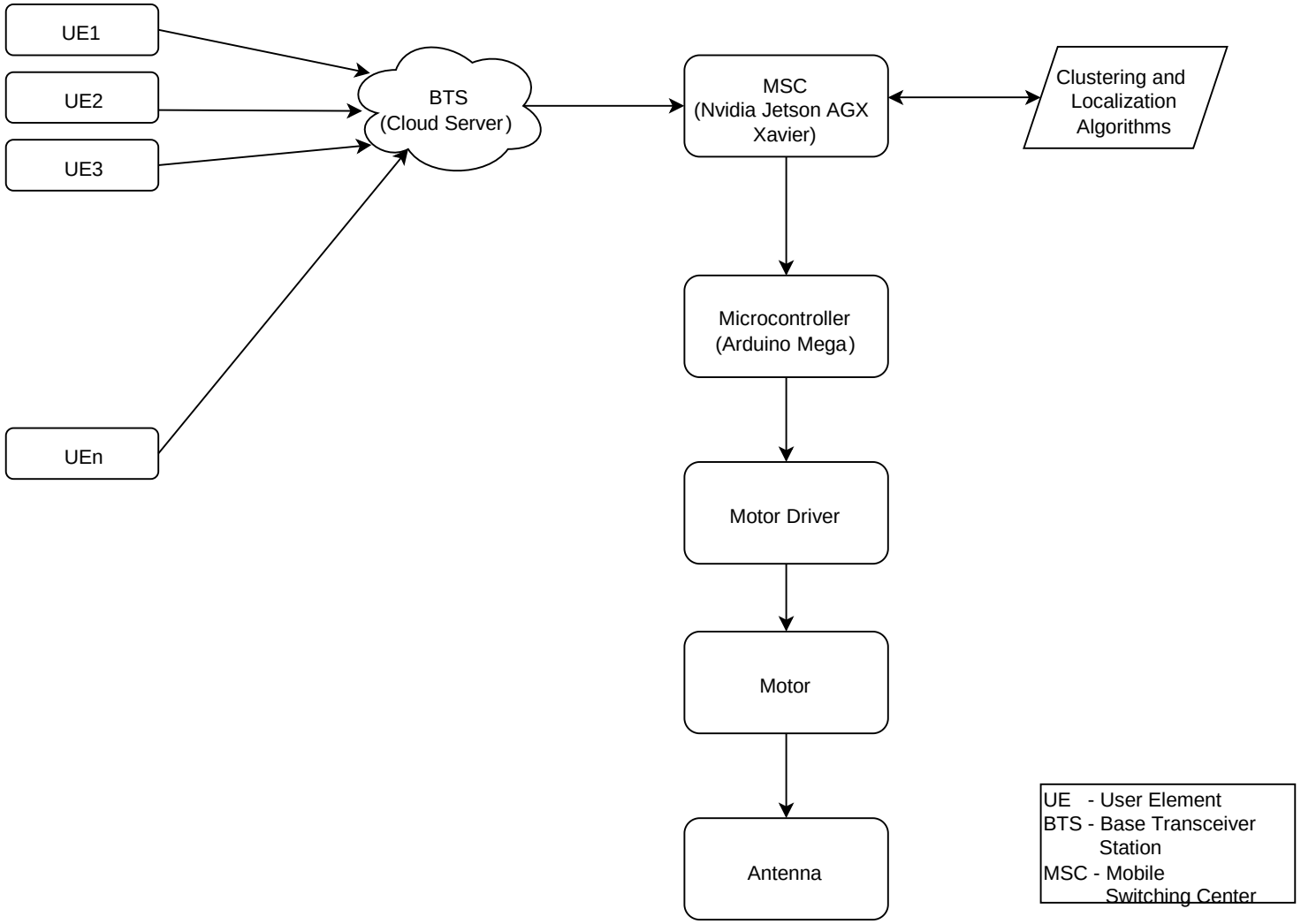
Reduced number of Antennas per BTS, a few can be used in remote areas

unlike current method of sectoring in less populated areas

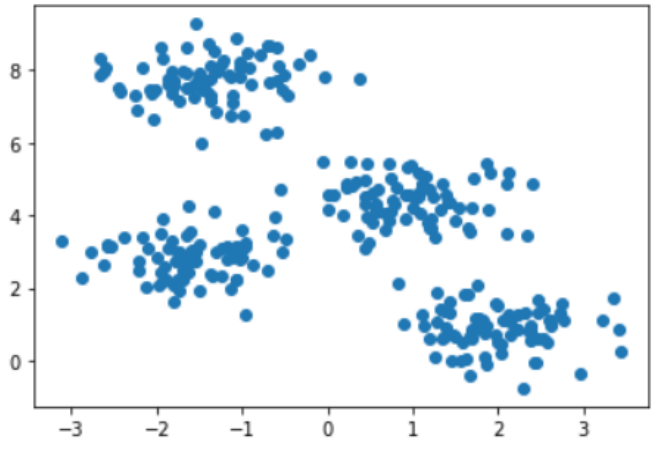
Roll-Out Cost

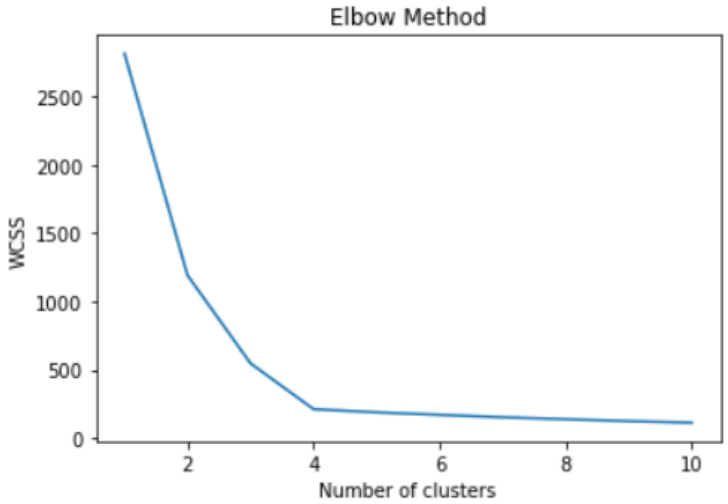
Section	Requirements	Cost in US dollars
Software	Digital Ocean (Cloud Server)	$50 per month
Hardware	<u>Control System</u> • Raspberry pi Microprocessor controller • Arduino Mega	 $50 $30
	<u>Drive System</u> • Encoded Motor • Motor driver • Power Supply • Power transmission-gears and bearings	 $1000 $200 $150 $2000
	Enclosure and mounting • Casing for electronics • Mounting brackets and screws • Pole adjustment fitting	 $500 $2000 $500
TOTAL		= $6530

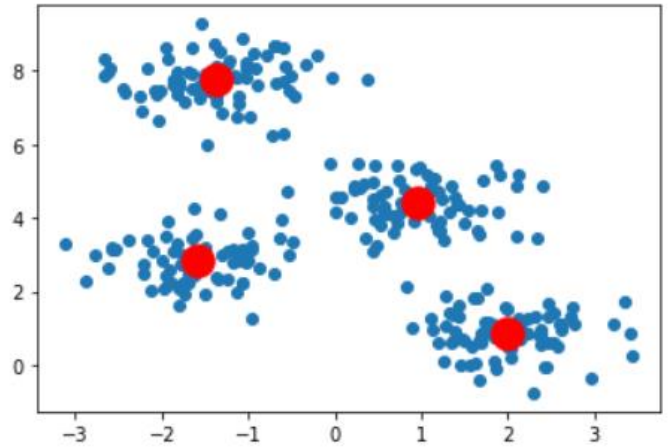
METHODOLOGY



ML CLUSTERING ALGORITHM - KMEANS







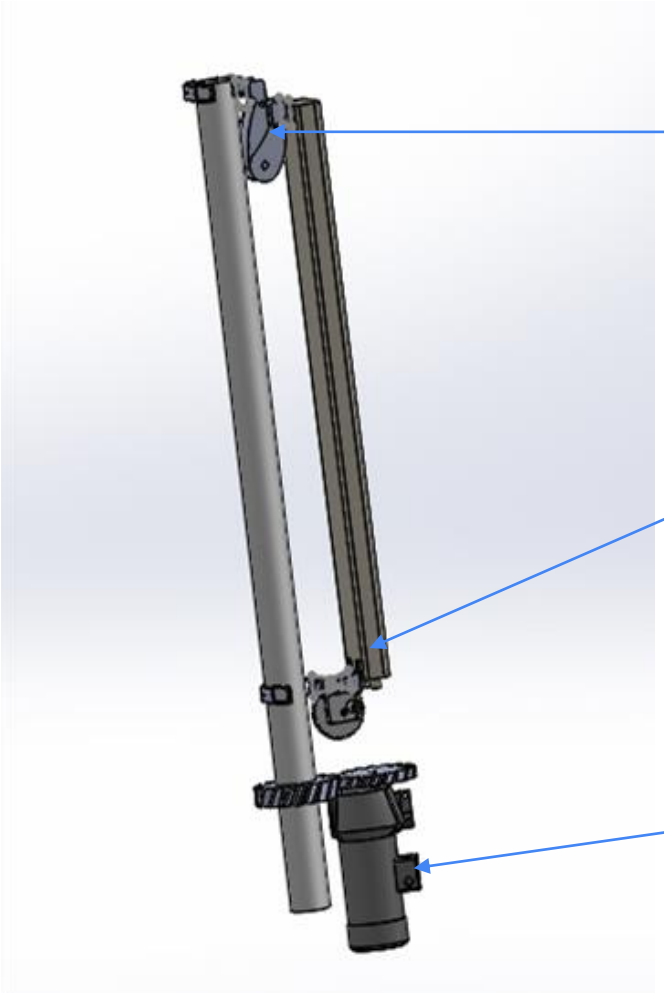
- Getting information about network users
- GPS Coordinates

- Cluster the users and determine optimal no. of clusters using Elbow and Silhoutte algorithm

- Select the largest cluster and determine its centroid
- Calculate Bearing based on centroid(Coordinates)

GitHub : KMeans Algorithm

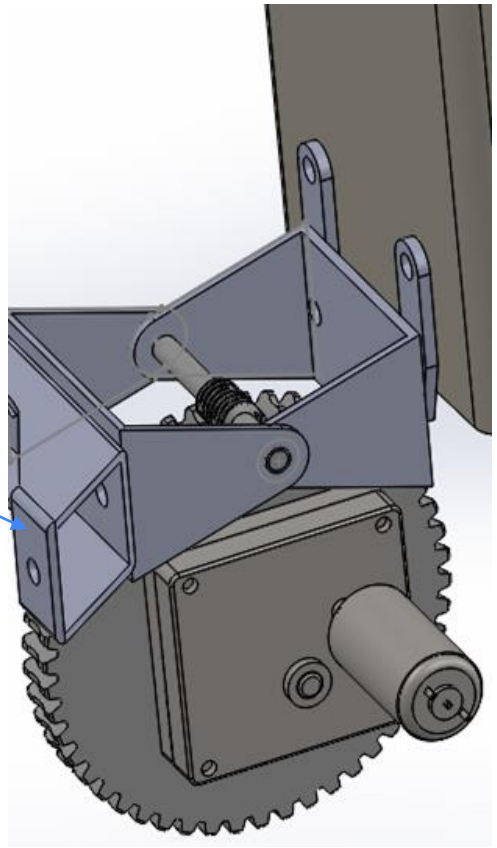
DESIGN OF ACTUAL ANTENNA



Linkages loosely set to allow for motion by the worm gear for elevation control

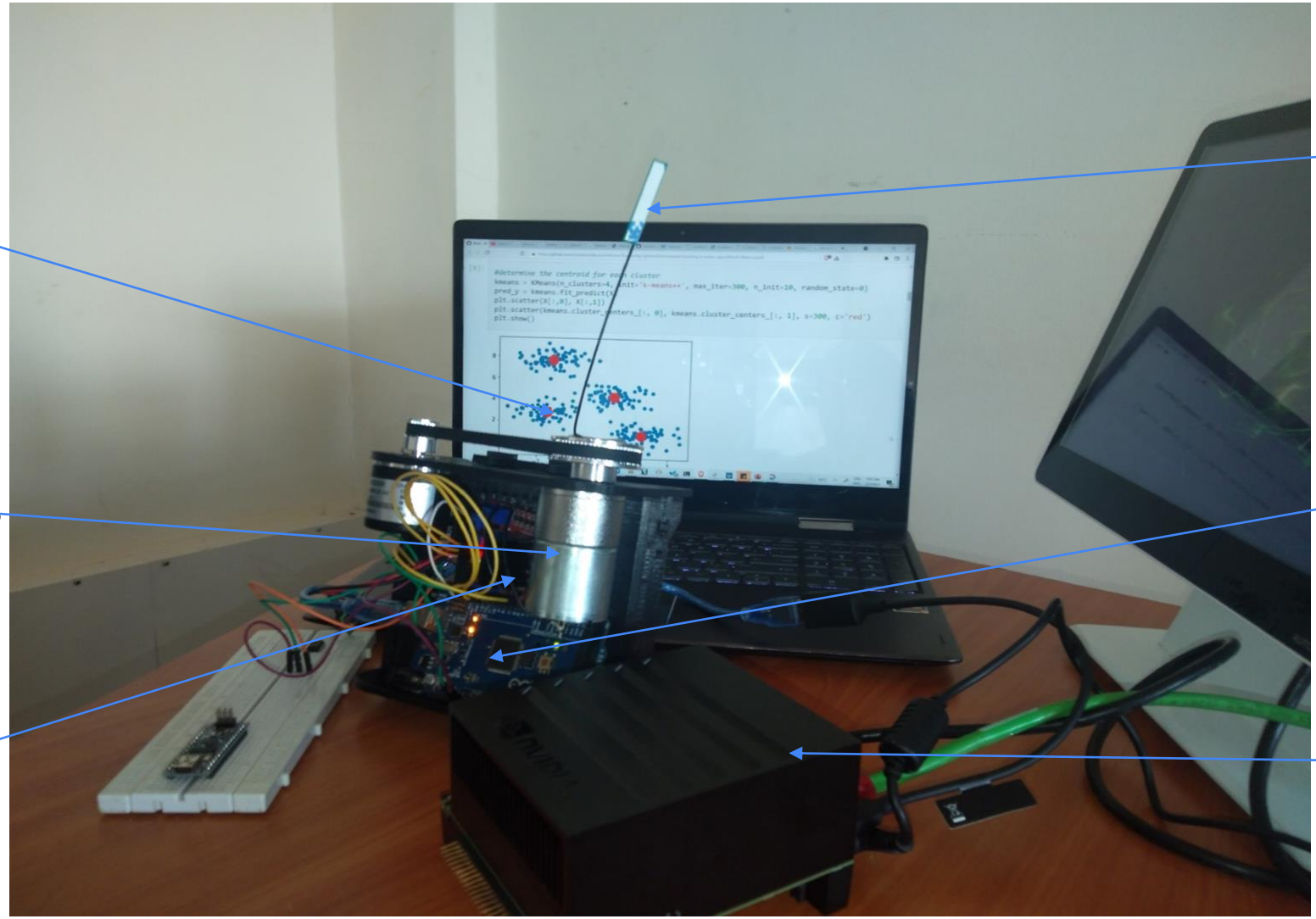
Inclination motion using a worm gear and position control motor

Rotation along z axis in x-y plane using helical gears and position control motor for azimuth control



Prospective design for the field antenna model : Kathrein 80010504V01

Lab Setup & Demo



Network user clusters

Motor (Mechanically Connected to Antenna and moves it)

Motor Driver(Controls Motor)

Antenna (Points to bigger cluster)

Arduino (Reads Jetson output(Bearing), Controls Motor Driver)

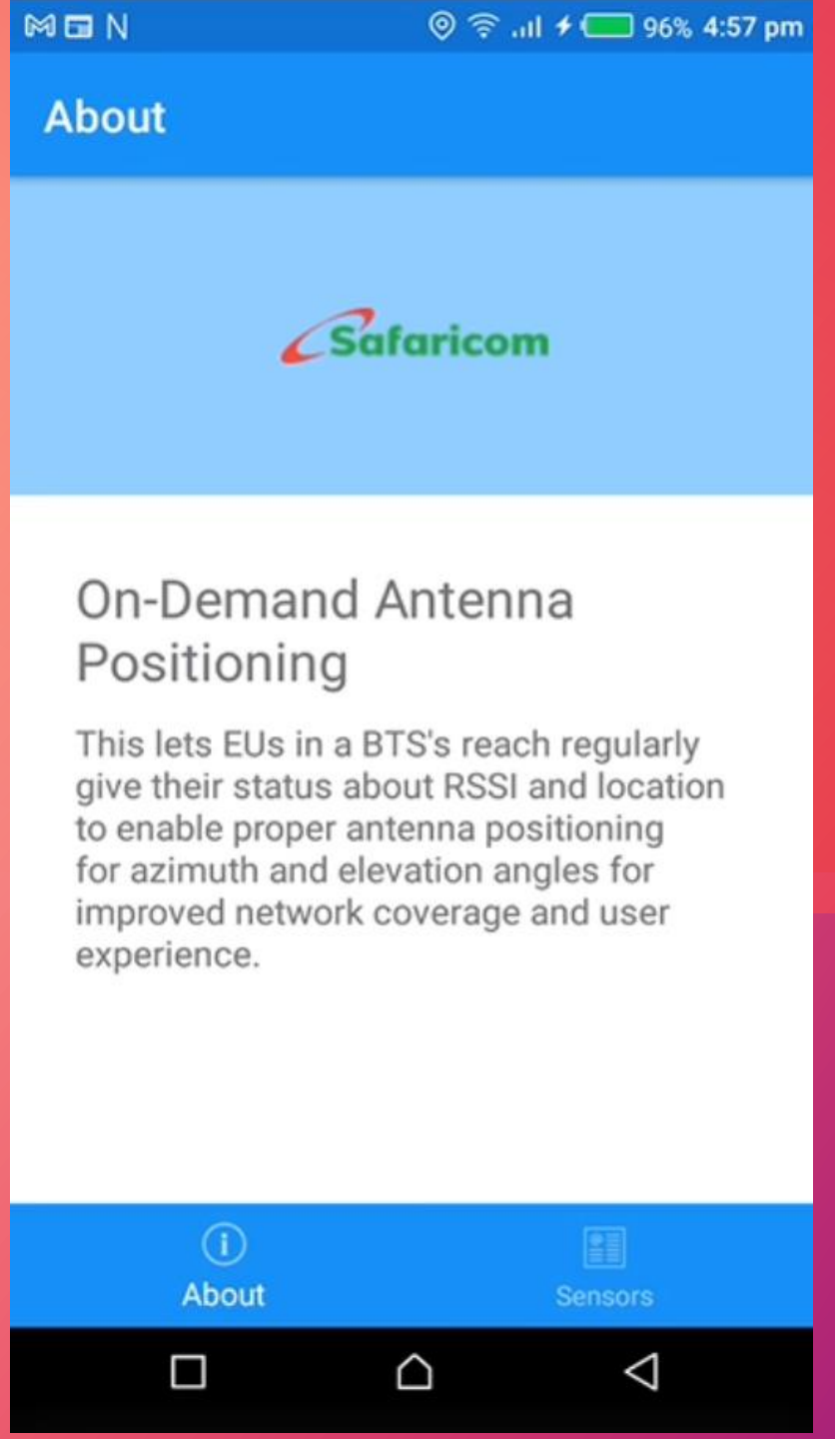
Jetson AGX Xavier (Runs ML Algorithm and Compute Bearing, Send result to Arduino)

Project Code : [Odap]

Challenges

- Figuring out the existing antenna technologies used by Telcom Companies
- Making sure that our project was economically viable regarding the existing 5G beam forming technology

Q&A



Thank You

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