

## **Inclusive traffic lights for visually impaired people. Case Study: Chía, Colombia**

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### **Summary**

Visually impaired people are particularly vulnerable to traffic accidents because road infrastructure and signage are not designed to meet their needs. This work aims to evaluate the implementation of technical improvements in the traffic light network of the municipality of Chia, Colombia, to provide greater road safety to this population group, so it is proposed to change the existing traffic light network by technological traffic lights under command, which will be installed in the points of greatest influx of people with visual impairment. The solution consists in the delivery of specialized handles to people registered with the authorities as sensorial disabled; these handles are internally linked to the operating system of the traffic lights, so that when people approach them they can activate them and warn the traffic light that they need to pass.

**Keywords:** Inclusive traffic lights, road safety, traffic control.

### **Introduction**

During the last century, automobiles became mass consumer goods that allowed individuals to move autonomously and effectively to places of interest. However, with the uncontrolled growth in the acquisition of vehicles, the expansion of road networks, the culture of citizens and urban planning around the passage of cars, a high concern was generated in global agencies regarding Road Safety, the prioritization of lives and the prevention of catastrophic events. Road traffic injuries are the eighth leading cause of death in the world, and the highest percentages of accidents are attributed to pedestrians, cyclists, and motorcyclists, who represent 54% of deaths within the global figure [1]. The situation tends to have even more negative effects in low- and middle-income countries such as Colombia, where 90% of these deaths occur in low- and middle-income countries [2]. It is for this reason that various initiatives have emerged worldwide, such as: Vision Zero, which is a road safety policy that was adopted by the Swedish Parliament in 1997 [3]

In addition to the above, as one of the main axes within Road Safety, the visually impaired are identified as one of the groups especially vulnerable to traffic accidents, because the infrastructure and road signs are not designed to meet their needs. According to WHO estimates, 285 million people worldwide are visually impaired and 39 million of them are blind [4]. It is therefore important to promote inclusive, independent, and safe mobility for people with visual impairment by adapting and regulating strategically crosswalks and places of recreation and main transit for these people.

This work aims to address one of the most important problems presented by the population of Chia, Colombia in terms of mobility and inclusiveness, such as the difficulty of passage of pedestrians with sensory disabilities at road crossings. To this end, a strategy will be defined to better adapt to the needs of the population based on the successful cases developed at the international level. In addition, it should be noted that this project aims to eliminate the barriers to movement and autonomy that disabled pedestrians have, improve their

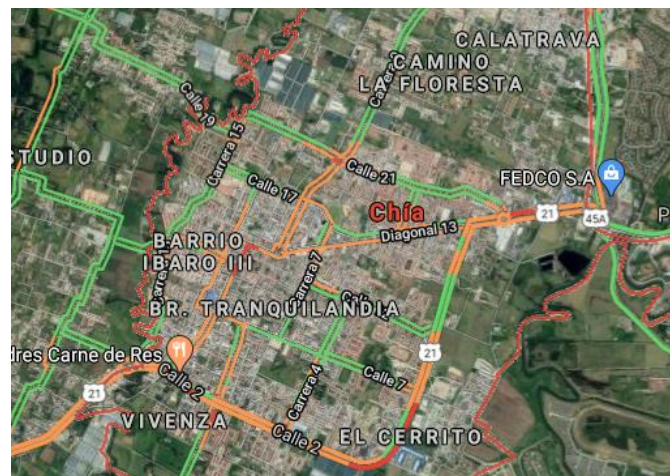
accessibility, contribute to road safety for pedestrians and drivers, and promote strategic, organized and conscious control of cars in the area of study.

### Area of study and methodology

Chía is a municipality in the department of Cundinamarca in Colombia, is located 10 kilometers from Bogotá in the Eastern Cordillera of the Andes. The urban area of the municipality has an approximate area of 17 km<sup>2</sup>, which corresponds to about 22% of the total area of Chía. According to the official statistics of the government of Cundinamarca, Chía is one of the municipalities with the highest density of the department and has become a type of dormitory city due to the high flow of people who move to the Colombian capital (Bogotá) and return after carrying out their work activities [5].

The municipality of Chía has two main roads, Avenida Pradilla and Avenida Chilacos, which make up a total stretch of approximately 8 km in length and cross the main points of the study area. In addition, the area is made up of a network of highways and roads that circulate around its urban, suburban, and rural areas, connecting them to each other and allowing good mobility between the different sectors. However, such mobility is affected by high traffic during peak hours, due to the presence of different types of road actors such as cars, trucks and buses that move along the internal and intermunicipal connections of the territory. [6]

Image 1 shows a usual traffic scheme for the municipality during peak hours.



**Figure 1.** Average traffic in Chía, Cundinamarca; Google Maps

As can be seen in Figure 1, this road network has 10 traffic lights strategically located in the sectors with the highest volume of vehicles, such as Avenida Pradilla. Most of the roads in this area have a medium level of traffic (orange color) specified mainly in the secondary roads of the municipality; this type of traffic is due to a high level of flow of different categories (cargo, motorcycles, buses, cars). In addition, it is common to identify sectors with fast traffic (green color) mainly in the exit areas of the municipality and within the suburban spaces of the sector (tertiary roads). Likewise, some sites are delimited with slow traffic due to the high probability of accidents and the large number of vehicles that converge at these points.

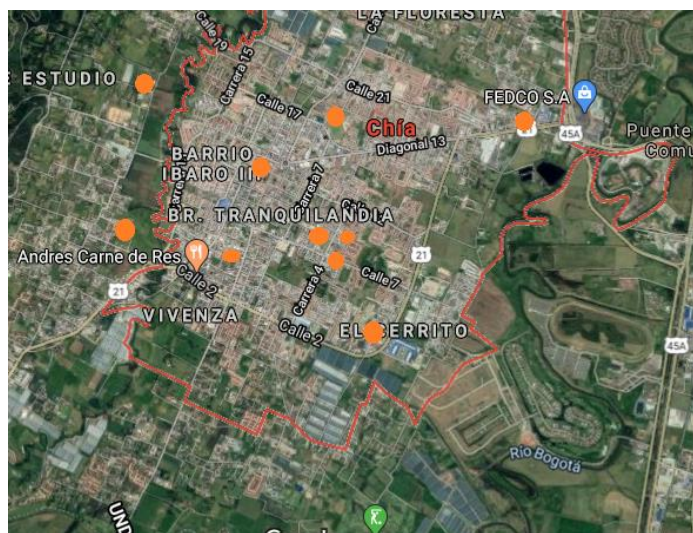
## Beneficiary population

By 1951, most of the population was centralized in rural areas of the municipality, representing 71.64% of the total population; while by 2005, due to the connection networks, the settlement of people in areas close to the capital and the expansion of the main cities, a population increase was generated in urban areas that constituted 75.43% of the inhabitants. Currently, the municipality of Chia (Cundinamarca) has a population of approximately 140,700 inhabitants, of which about 110,600 people (78.60%) are located in the city; this represents an increase in the number of individuals who move around the municipality and the potential increase in road accidents.

Additionally, according to the DANE, 223 people have some type of serious difficulty perceiving light and/or distinguishing objects or people despite wearing glasses. In addition, the municipality has about 180 people who are blind [7] and, according to the projections of vulnerability, it should be taken into account within the affected population those individuals who may develop partial or total loss of vision, as is the case of the adult population (over 69 years) which in 2014 registered approximately 5,321 people [8].

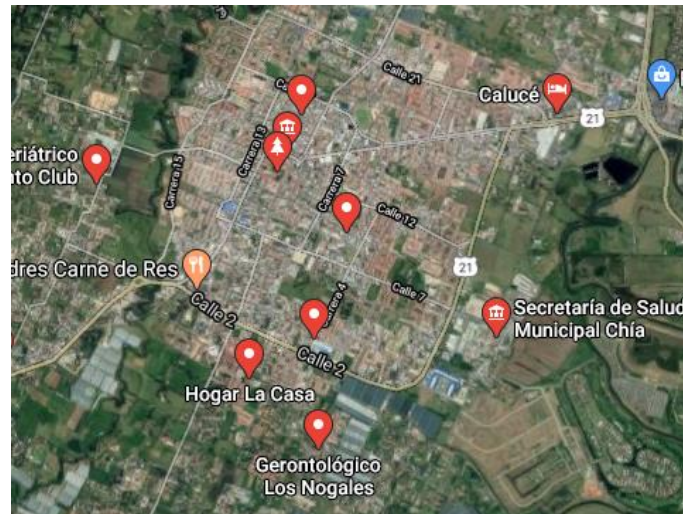
## Selection of implementation points

In order to define the intervention sites for the proposal, the areas of the municipality where facilities related to specialized care for people with visual impairment are located, such as schools, care centers, hospitals, adapted recreation centers, among others, were specified. This was done to identify and delimit the sectors with the greatest presence of the target population. Figure 2 shows the location of these centers.



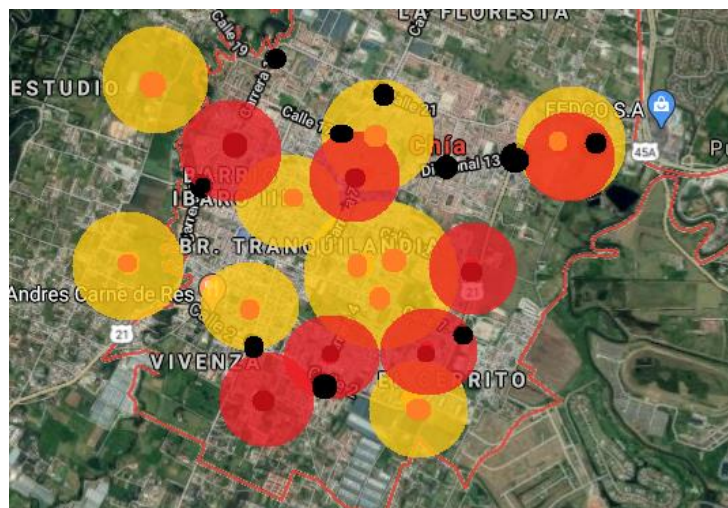
*Figure 2. School and support centers for the blind, Google Maps*

Considering the vulnerability of older adults to the loss of their autonomy, specialized care centers were determined for the treatment and care of this group. The results are shown in Figure 3.



**Figure 3.** Elderly Care Centers, Google Maps

Finally, and based on the previously defined sites of interest, the traffic-light intersections where the capacity of people with visual impairment is higher were chosen. Figure 4 shows the selected intersections.



**Figure 4.** Zones of influence of blind and elderly points, Own elaboration

The areas represented by orange dots correspond to the institutions and schools that serve blind people, and therefore represent the sites of greatest traffic of the population; on the other hand, the areas identified by red dots are those where there is a greater presence of adult population (over 69 years); finally, the black dots correspond to the location of traffic lights in the municipality of Chía.

Based on the above, the chosen points have the following addresses in the municipality of Chía, Cundinamarca.

- Point A: Carrera 10 with Calle 2 Reference: Puente Guaymaral



- Point B: Carrera 4 with Calle 2 Reference: Parmalat
- Point C: Race 1 with Calle 7 Reference: Lavafante
- Point D: Diagonal 13 #4 East-306 to 4 East-234

### **Traffic light system**

The existing traffic light network will be replaced by the new technological traffic lights under command, which will be installed at the critical points mentioned above. The alternative consists of delivering specialized handles to people registered with the government authorities as having sensory disabilities. The handles are internally linked to the operating system of the traffic lights, so that when people approach them, they can activate them and warn the traffic light that they need to pass. When the handle is operated, the traffic light emits a sound and vibration signal that lets the user know that he has been given the command [9]. The user's crossing is controlled by two important moments corresponding to the instant in which the pedestrian crossing is enabled (green light) and when the crossing time is about to end (yellow light), during these intervals, the device generates two specific sounds accompanied by pulses respectively. In addition, in the areas surrounding the crosswalk, podotactile tile systems will be available to facilitate the transit of people and to prevent loss of orientation during the crossing. It is necessary to mention that the traffic lights will have an individual solar panel that will allow the collection and transformation of the solar brightness into electrical energy that will contribute to their operation [10].

It should be noted that the proposal of the traffic light system by command action is convenient because it represents multiple benefits for the inhabitants, the administration and even the image of the municipality. Among the main advantages is the inclusion of visually impaired people in the community, through the ease of adequate and participatory movement, benefiting the state of people and contributing to improving their quality of life. In the same way, during the search for a viable solution for the community of Chia, the possibility of implementing technological strategies in the crossing of streets was evaluated. However, and due to the fact that the residents of the municipality are mostly people of adult age and that normally they do not have a Smartphone at their disposal, it was concluded that the best alternative was the installation of the portable handles that represent a simple, intuitive and effective methodology.

In addition, the implementation of these systems significantly improves the image of the municipality and becomes a point of attraction for people seeking to belong to inclusive sectors. On the other hand, from the implementation and development of the project it is possible to create social and commercial value for institutes, corporations, societies and foundations belonging to the area of study, which are focused on helping people with disabilities of this type, giving them a plus so that people know them and can go to them.

### **Conclusions**

The implementation of traffic lights by command is an important sustainability factor associated with the reduction in the use of polluting fossil fuels used in the processes of transport by individual vehicle. This is because by increasing the safety of disabled

pedestrians at road crossings, residents are allowed to walk to places of interest more independently and contribute to one of the main objectives of Transport-Oriented Development, which establishes the importance of creating inclusive and walkable environments for individuals. In addition, the installation of individual solar panels on each device allows the municipality to create a clean source of energy that contributes to the operation of the devices and allows them to operate correctly during their lifetime.

Likewise, the activation of these systems favors leisure environments and interaction among users, generating an important added value to the image of the municipality, and encouraging the surrounding regions to implement alternatives for social improvement. In addition, by allowing a greater flow of people with disabilities around the sector, it favors that the establishments related to institutes, foundations and/or companies related to the inclusive treatment, acquire greater visibility by the population.

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