Follow Me Travel Bag

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Abstract: Follow Me Travel Bag is basically a smart bag to be used by travelers in away that provide them with additional features the normal travel bag does not. This bag will be empowered by a built-in tracking system that provide automatic self-control over the bag. It will integrate modern technology to provide easier usage of a travel bag, and enhance the security and movement issues. The main objective of this project is to ease the travel experience of individuals in handling their travel bags throughout their movement. This is accomplished by firstly making the bag following its owner without a need to drag it. Secondly, the bag will contain a location finder system to overcome the possibility of being lost, forgotten or stolen. This will solve the problem of losing the bag forever among with its contents which are valuable in much cases. This research is investigating the most suitable approach to achieve these targets though designing, controlling and testing of a smart programmable tracking system inserted in a travel bag.

Key Words: following system, smart bag, Pixy sensor, camera, tracking system.

I. INTRODUCTION

Follow Me Travel Bag (FMTB) is a project driven by the intention to make the travel experience of individuals and groups easier, safer and more convenient by investing new technologies. The system is about developing a smart bag that have more functions and features than the traditional one, some of them are: the ability to follow the owner, alarming system and location finder. The bag is empowered by a programmable tracking system through a microcontroller chip placed in the travel bag. The main function of this microcontroller is to receive the input from the different sensors in the bag and then process this input which represent a reading of the surrounded environment, and lastly to produce an output which is a movement management for directions and path, through the motors. This concept is enhanced with a security system to assure the safety, which is indeed a very considerable aspect when coming up with a useful and powerful product. The security will be basically by putting an alarm that will be activated if the bag is in an unsafe range, and this alert is essential to prevent forgetting or stealing the bag.

The security system will also contain a location founder system with the help of GPS and GSM technologies, to detect the exact location of the bag in case if it is lost anywhere. This project include the implementation of digital signal processing to observe the surrounded place, coding to generate the controlling policy, and Internet Of Things to connect the user with the bag and grant him, control over it. This project is to be used by travelers of plane, car, buses or ships, it is applicable for both individual and group travelers of all ages, genders and nationalities. Lastly, the FMTG project will save the travelers belongings, energy and valuable time in addition to the ability to overcome the problems of stolen, lost or forgotten bags, since hands-free bag equals hassle-free bag.

II. RELATED WORK

The main focus in this session will be about the major works done in two main areas, the first one is following/tracking systems, the second is the location finder system which is about tracking an object using GPS/GSM technologies.Moreover, there have been many strategies to follow people and objects in the indoor and outdoor environments using plenty of possible approaches, these approaches vary depending on the nature of the system and the involved application domain, for exmple,[1] Invested the technology of following mobile robots in following patients to assist them during walking experiences and then, guide them back to their rooms. However, most of researches are not very concern about the application domain, rather, they keep the design flexible so that the user can invested based on his/her needs, and they focus more on achieving specific functions [2,3,4].

One thing that is observable and commonly used by most the following approaches is the existence of a camera. This essential component is needed to perform several tasks, among them and the most important one is to provide an input for the processer to control the system. Nevertheless, it can be seen that some projects intended to replace the camera by laser scanners. However, this approach may lead to inaccuracy in many cases. Moreover, among the various cameras that are available and have been used, a noticeable focus was in the direction of using Kinect camera. For example [2,3,5] used Kinect camera sensor which is mostly used and preferred over other options like melting sensors, due to its relatively low cost and affordability.

Hence, it can be observed that the Kinect camera is a good choice since it has a built-in microchip for image processing named as (Primesense's PSI080-A2').

This particular ability release the user from hardship of handing the image processing separately. Nevertheless, in [5] the authorpreferred to use a 360-degree omnidirectional camera sensor and can be combined with several synchronized panoramic cameras. The reason behind this is that in omnidirectional camera the whole picture of the

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surrounded environment is viewed. Which eliminate the possibility of the followed object being escaped from the camera range. For those who are using the Kinect camera approach they gave attention to this problem and tried to solve this issue in different ways.Different systems deals with these problems in different approaches, mainly based on their application domain and area of implementation. For example,recent studies outlined by [2] suggested that a three-step procedure will be enough to handle these shortcomings, which can be described by 1. Using the Simultaneous Localization and Mapping (SALM) algorithm, 2. Noise filter to optimize the results, 3. Following and tracking functions that use face features to localize and tracking specified people based on SLAM result.

In term of tacking the location of an object, many use cases have been proposed and implemented in the real life domain.The tracking approaches vary with respect to the domain of application and other functionalities that the system will implement. However, related to FMTB project, both papers of [6, 10] provided very interesting domains the implement the tracking method. Both approaches discuss the implementation of a location finder technology in airports. Which are basically to be used by the airport management to check and track passenger's luggage during traveling from a departing station, until he/she reach to his/her destination, both papers [6, 7] uses Radio Frequency Identification RFID to create a unique number called RFID tag which contains the passenger details.

Previous work foused on diffrent ascpects, [1] for example focused on the use of these systems in tracking a vehicle and control its speed by putting a speed limit and he enhanced the system with the SMS service. While on the other hand, B.G. Nagaraja [2], focused his effort to produce an effective anti-theft system that is capable of informing the user with the location of the car in case of the vehicle has been stolen, which is related to FMTB security system which implement a quite similar way to inform the passenger with the major main difference which is in the nature of the object being reported.

III. PROBLEM STATEMENT

A major problem for travelers is a case where their travel bag is lost, forgotten or stolen, this means in most cases losing valuable items for them. FMTB provide a solution to that by empowering the bag with a tracking system that is capable of informing the owner by the bag's location. In addition to that, FMTB solves the problem represented by the hardships that the owner of the bag may face during drugging the bag and moving, especially for disable people and elderly. Hence, the bag is provided with a following system to take away that hassle.

IV. OBJECTIVES

The main objective of this project is to design a prototype of following and traking system. The specific objectives are:

1. To design a smart bag that is capable of following its owner and moving along with him at a processing speed of 50 frame per second.
2. To develop a location finder system to enable the owner to trace the bag's location by sending him the exact location in cases the bag is lost, forgotten or stolen,through GSM/GPS modules.
3. To develop a security system that can alarm the user about different cases, that may be encountered such as: unexpected separation, losing the bag, or forget it by placing a buzzer in the bag to catch the user's attention.

V. COMPONENTS

Arduino Uno is used in this project as the main microcontroller for controlling the movements and other functions and features of FLTB. While to bag that will be used for this particular project is a 20 KG bag, and it can be implemented in other bags after doing the needed adjustments. The core component in this project is Pixy (CMUcam5) smart vision sensor, which has the ability of processing data at a rate of 50 frame per second, which provide fast and effective detection ability. Two 12v DC motors are used to provide the system with the needed movement, in addition to a EM-406A model GPS module to get the location and SIM900 GSM module to estabilsh the communication with the user.

VI. TESTING

Testing is the process of finding differences between the expected behavior specified by system models and the observed behavior of the implemented system. Hence, before proceeding with the a actual architecture and implementation on the bag itself, it is important to test the algorithm, coding and functions on a smaller-size system to avoid any losses or casualties that may happen, and to make sure that every component is working properly. Furthermore, the main components are fixed during both testing and implementing sessions, these components are: Arduino microcontroller, Pixy camera sensors, GPS module and GSM module. Other components will be replaced with cheaper ones for the testing purposes only, such as: motors, wires, buzzer, and the LEDs.

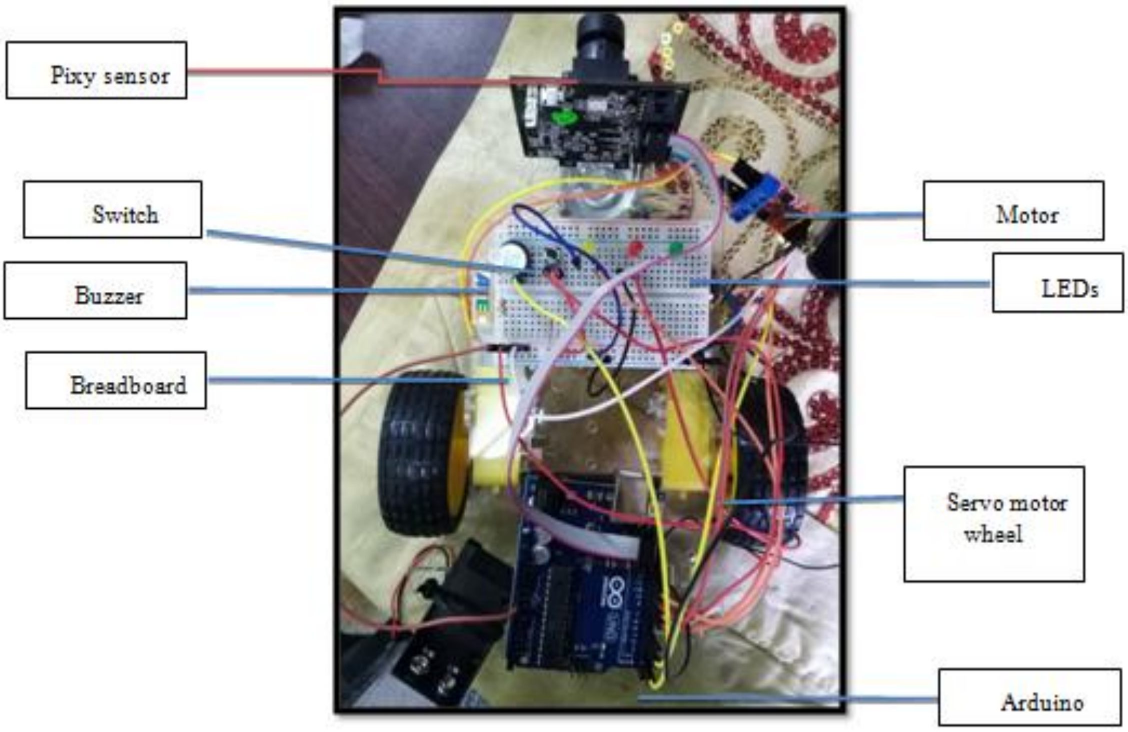

Fig . 1 Testing Robotic Car

Hence, the algorithm for the following system can be described by the following points:

• Pixy does the scanning function of the surrounded environment.

• User input the color of the intended object to be detected.

• If the object is present, it will be named uniquely by Pixy.

• Pixy sends width, height, X and Y coordinates as input data to Arduino microcontroller to be processed.

• Arduino observe the location with respect to the X and Y coordinates and further calculates the area of the object and well as.

• Pixy keep sending updates to Arduino in case of any changes/movements in a continuous rate of 50 frame per second.

• Arduino receives the input data and take the suitable action.

Fig . 2 response of pixy

In figure 2, the reaction of the car is obsererved as the object is changing its position, in which the car is moving forwared, backward, left and right with respect to the object location. LEDs are used for illustration.

VII. RESULTS ANALYSIS

In this session the acquired results are analayised, and it is important to strart with the object detection ability in Pixy, figure 3 shows the object detection function in Pixy sensor, in which the colors of the intended object are highlighted inside a square, and it has a very good ability of keep tracking the detected object while its moving, since it process 50 frame per second, and this output shown in the figure is how it looks like in the PixyMon application, which enable to user to see what pixy sees. Furthermore, pixy does this function through image processing approach which is done internally through a powerful microchip. And it can detect up to 7 signatures colors which are: white, blue, green, yellow, red, orange, violet and indigo.

Fig. 3 Object detection in Pixy

These colors don't represent the ability of Pixy, rather they stand for the main features that help Pixy to detect things. However, in case there is an object that contain more than one color and it need to be detected, Pixy offers the color code solution, which is shown in figure 4. By which an object that contain more than one color is treated as a single signature. Pixy can accommodate up to 7 different color codes, in addition to another 7 different signatures.Moreover, after Pixy detects an object it starts sending the input data to Arduino in order to process this information and act upon them. The information are updated continuously as the object move in any direction. Figure 5, shows a sample of these data/ values, which inculde: height, width in addition to the X and Y coordinates.

Moreover, from a number of experiments conducted, it is noticeable that as the number of colorcodes increases, the effectiveness of the following scheme also increases. For example, when the pixy is taught to follow only one signature of an object with a unique color, it is possible that the case will occur where pixy is detecting another object that has the same color in the surrounding environment if the main object disappeared. On the other hand, when the detected object contains a color code (more than one color), it has a much high level of robustness. This is because the possibility of finding an object within pixy range that has the same colors of the color code decreases as the number of colors in the color code increases. Hence, and for this particular reason we decided to use a color code of 4 different colors and that would make it very rare and almost impossible to have a similar color code in the surrounding environment and this lead to the disappearance of the case where pixy is following the wrong object, figure 6 illustrate this concept.

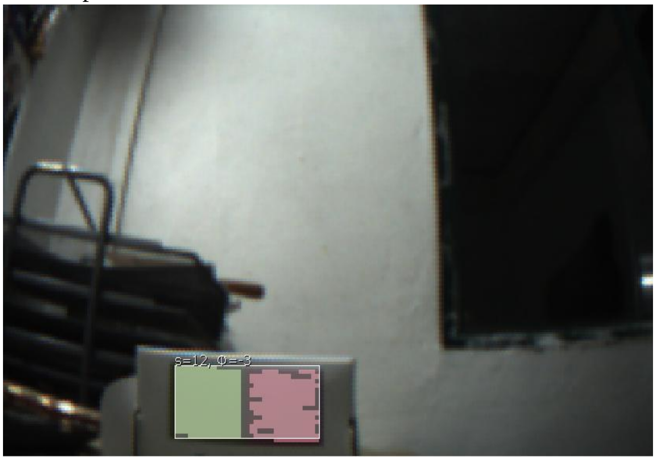

Fig . 4 color code in Pixy

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COM3 (Arduino/Genuino Uno)

  block 0: CC block! sig: 12 (10 decimal) x: 180 y: 101 width: 64 height: 30 angle 0
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 180 y: 101 width: 64 height: 30 angle -1
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 180 y: 101 width: 65 height: 30 angle 0
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 180 y: 101 width: 64 height: 30 angle 0
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 153 y: 104 width: 56 height: 26 angle 0
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 108 y: 105 width: 48 height: 24 angle -2
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 99 y: 104 width: 46 height: 24 angle -2
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 215 y: 110 width: 44 height: 21 angle -2
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 201 y: 110 width: 47 height: 21 angle 0
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 185 y: 109 width: 47 height: 22 angle 0
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 182 y: 115 width: 128 height: 63 angle -1
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 178 y: 145 width: 143 height: 70 angle 0
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 184 y: 100 width: 53 height: 26 angle -2
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 188 y: 108 width: 43 height: 22 angle -2
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 193 y: 135 width: 23 height: 11 angle -18
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 182 y: 97 width: 37 height: 18 angle -6
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 73 y: 101 width: 41 height: 26 angle -8
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 168 y: 95 width: 46 height: 24 angle -2
Detected 1:
  block 0: CC block! sig: 12 (10 decimal) x: 267 y: 107 width: 38 height: 21 angle 0
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Fig . 5 data of the detected color code (2 colors)

Moreover, the maximum distance is a very imporant vactor to be observed, therefore, 10 diffrent objects were tested to get the maximum detectable distance for each one them, objects are are: small square, lighter, small box, medal, sticker, note book, bottle, pillow, and bucket, and table 1 list the item's name and area for the purpose of comparing the effect of object's area on the maximum detectable distance by Pixy camera sensor.

Futhermore, from the data in fingure 7, it is noticeable that as the actual area of an object increases, the maximum detectable distance also increases. However, the area of an object is not the only factor the affects the detection ability, the level of color also play an important role. For example, the area of the bucket is smaller than the book, but since the color level of the book is more focused, Pixy can detected with a longer distance then the bucket. Moreover, the maximum distance noted is about 500 cm (5 meters), and that would be suitable when object is quite big and if the needed distance between Pixy is in that range, nevertheless since the bag will be closed to the user in this project, it is preferable to have a small object with a unique color to be followed and it is meaningful to remind that there is not a specific of fixed distance that the object must be in once the system is started, except the maximum one, rather, Pixy will calculate the area of the object during the first 500 millisecond and set the value of the area to be the reference distance.

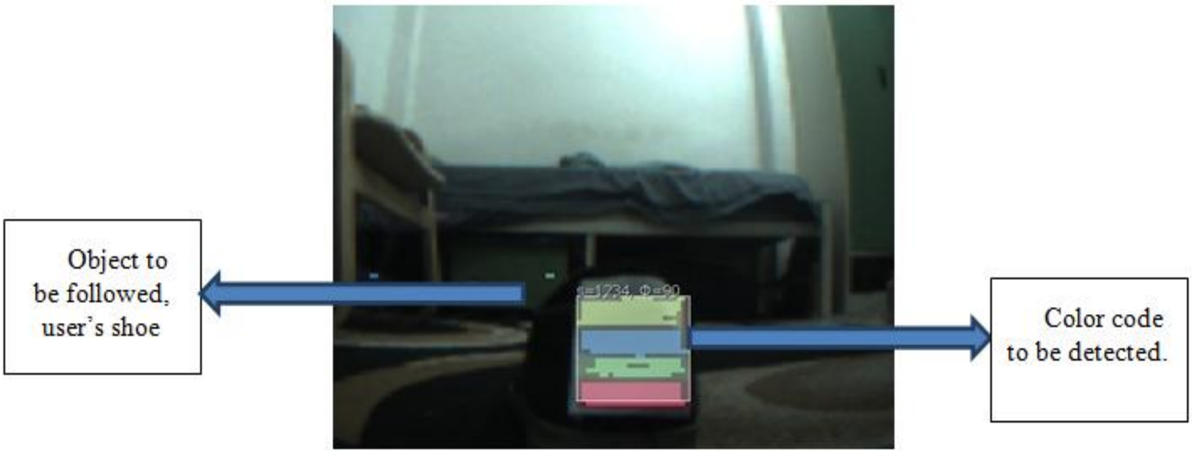

Fig . 6 code code detection

Table 1. Areas of Different Items

Item	Area (cm2)	Item	Area (cm2)	Item	Area(cm2)
Sticker	4	Lighter	11	Book	368
Square	4	Box	65	Bucket	144
Medal	15	Bottle	154	Pillow	2600

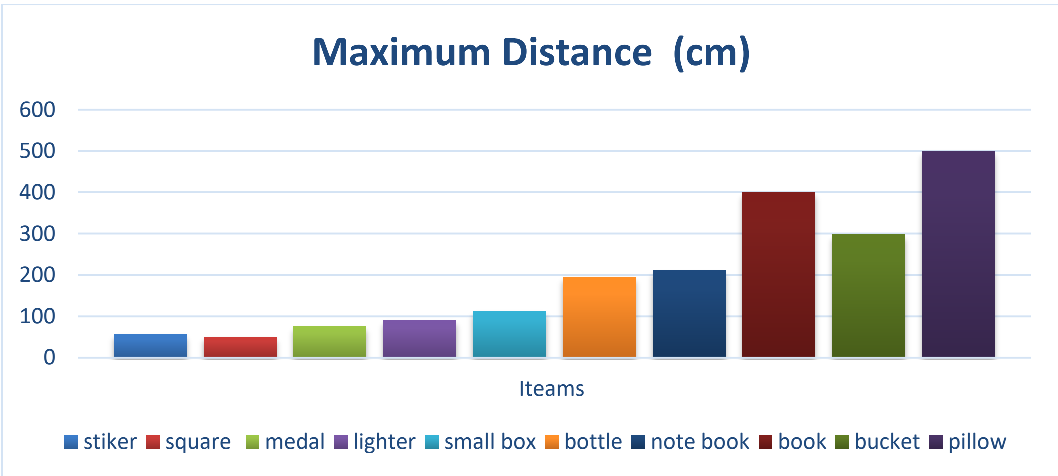

Fig . 7 Maximum Detection Distance

For the tracking system, the out coming results of the tracking system of the bag is investigated, in which it contains a SIM900 GSM module among with GPS module. The communication between the user and the bag will be through SMS messages in which, the GSM is sending the loction details of the bag whenever, the user sends a predefined request message. This is made possible since the GSM module contains a real time SIM card inserted inside it, so all he needed from the user is to save the number of the SIM card on his phone, and request the location whenever needed. Figure 23 shows the circuit of the GSM and GPS modules connected to the Arduino microcontroller board. Moreover, when the code in appendix B is uploaded to the Arduino, the result of the serial monitor is shown in figure 24, in which the values of Latitude and longitude are given, and by that it is easy to copy the values into Google map application for instance and get the location. Furthermore, the response time between the user and GSM module is tested, and after a 40 message we reach the conclusion that it is almost 50% that the response time will be 21 seconds from the moment the user sends the request until he gets the reply.

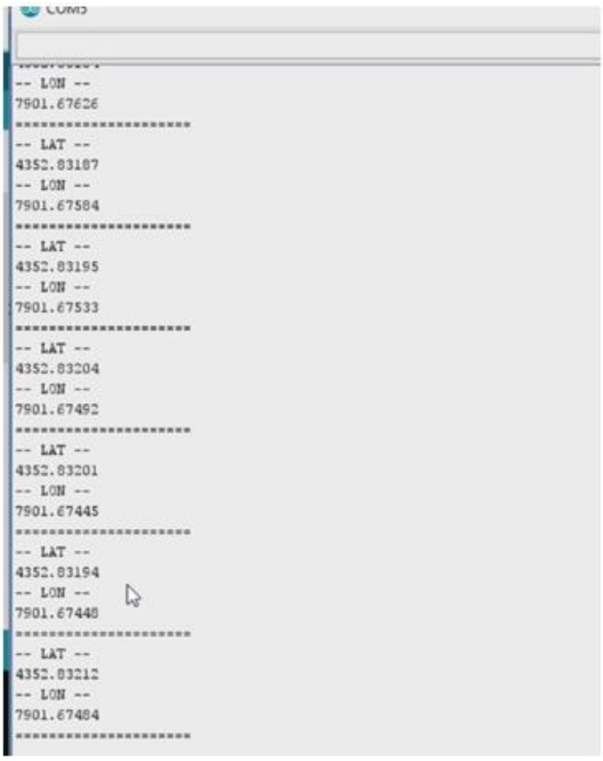

Fig . 8 Latitude and longitude values from GSM/GPS modules

VIII. CONCLUSION

In conclusion, based on tests and results reached, we were able to produce an efficient robust following system that has very fast detection ability of 50 frame per second, using Pixy camera sensor among with two 12v DC motors. This following system is used to empower traditional traveling bag with the ability to detect and follow its user while walking around. Experiments were made to verify the effectiveness of the movement. This new functionality added to the bag takes the hassle of dragging the bag away from the traveler. The new smart bag has in addition a security system that is represented by a GSM/GPS modules that sends the location of the bag through a SMS message to the user in case it’s forgotten somewhere, or got stolen among with an alarm in case of unexpected separation . FMTB solves some troubles that a traveler usually face during his journey and make it easier for him to deal with the bag. Moreover, the need to FMTB increase in case of being combined with many bags or in case of user being disabled or an elderly. The Pixy camera which is the core sensor in the system provide choice of changing the object being detected. The detection ability is based on observing the colors of object, it can be any object the user decide to set wi th only one condition which is having a unique color and for better results it is preferable for the object to contain more than on color (color code).

The objectives of this project were successfully achieved by all means by the testing phase and by integrating and investing the behavior of different sensors and use their abilities to serve the intended objectives. Furthermore, the system is working properly and dose the following and tracking functions in an excellent manner.

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