

Development of parked vehicles searching system

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Abstract: In this research, we developed a system, which can find the location of vehicle when people park their cars in a big parking lot or large area. People can find their cars readily through this simple device and they can save their time and effort. This is the purpose of this research. Performing this, detection of electromagnetic wave's direction is needed and we used shielding effectiveness of electromagnetic waves for the method of it. An absolute coordinate indicates four directions (E, W, S, N) by using an electronic compass module, and it is needed for the localization. The device can check the received count of the electromagnetic waves coming from all other directions through the system, which is installed in the vehicle. The direction recorded the least received count would be the location of the parked vehicles. We can add on the function of this research by using the same frequency of cars alarm goods. Also, it is useful in the huge indoor parking lot.

Key words : detection of electromagnetic wave's direction, shielding effectiveness, electronic compass module

1. INTRODUCTION

2002 standard, the whole vehicle retention figure of Korea passed over 11,000,000. Parking lots of department stores, stadiums and large discount markets are gradually becoming large size and getting complicated structure because of increasing of vehicles explosively. The vehicle owners spend a lot of time and energy when they forget the vehicle's location after parking.

Generally, a popular car alarm product has the system, which is finding the location of the car. This system can turn on and off the lights of the vehicle and make a warning sound when users send the signal using the remote control. Then, users can find theirs using a warning and blinking emergency lights. However, this system has a lot of problems such as the limited distance and the difficulty of finding vehicle.

Recently, the GPS that is of great use has a problem; they cannot use it where underground such as basements or crossed rooms due to the weak signal of the GPS. There is some branch method which complements like this problem point of GPS. But the relay station the same additional system comes to be demanded, also the establishment expense plentifully is necessary. Also, parking vehicles position grasping which use GPS in a lot of large size indoor parking lots may be hard. In this study, own parking vehicles grasp position more easily through simple device wish to reduce timesaving and unnecessary energy dissipation.

2. Composition of development device and operating synopsis

Whole composition of development device is user remote controller and System that is installed inside vehicles. Operation of development device is send electric wave that contain unique ID from user's remote control to vehicles and System that is installed inside vehicles detects direction of this electric wave. Using shielding effectiveness of wave, grasp direction position of electric wave. Send position data of vehicles to user. Position data information that user receives includes four Direction, After through LCD of remote control, see compass and grasp position.

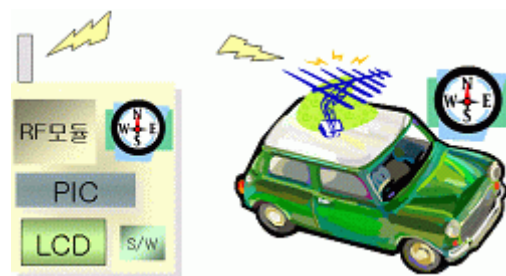


Figure 1. Whole composition of development device

System that is need absolute coordinate between user and vehicles for position grasping of parking vehicles and threads inside vehicles for this used electron compass module and position grasping of each other through four directions is possible. Total 3 PF modules from developed device do both way communications. System that is used one to user remote control and threads inside vehicles uses total 2 RF modules for

communication with user and direction detector of electric wave. Frequency uses 447MHz and this is frequency that is used commonly widely in existent vehicles alarm product.

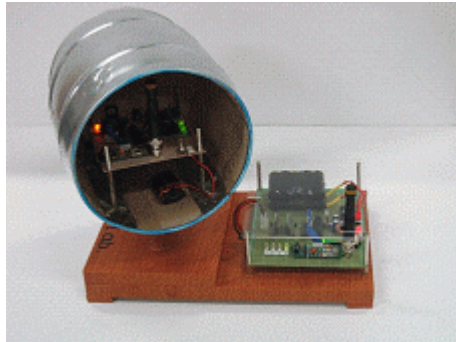


Figure 2. System on vehicles

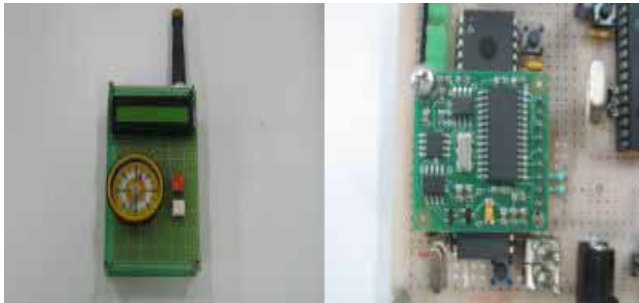


Figure 3. Remote control and Electric compass

3. Design of development device

3.1 Shielding Effectiveness

Shielding of electromagnetic waves means it prevent that electromagnetic waves from outside transmit to inside through reflection or absorption by shielding material, shielding effectiveness means that degree which the electromagnetic waves from outside is comes to be reflected and decreased from the medium.

Consequently, shielding effectiveness comes to be expressed with afterward together.

$$\begin{aligned}
 SE(dB) &= 20\log_{10} \frac{\text{incident field}}{\text{transferred field}} \\
 &= 10\log \frac{P_1}{P_2} \\
 &= SE_R + SE_A + SE_{MR}
 \end{aligned}$$

Shielding effectiveness is defined with the fact that unites of the loss of 3 type of the effect reflection loss (SE_R), water absorption loss (SE_A), multiple reflection loss (SE_{MR}).

The general way of shielding effectiveness we uses the metal that transmission is excellent or magnetic permeability is big.

The material of shielding effectiveness is used the pure metal of the copper and iron. Skin death is a good material of shielding effectiveness. Because it has high reflection ratio and absorbs electricity transmission and magnetization and more than 40db shielding effectiveness. In this experiment we use iron because it is easy to buying and it has high shielding effectiveness.

3.2 Detect a radio wave

There is method that use method, method that use directional antenna, shielding Effectiveness that use GPS to electric wave Direction Finding method. There is method that use method, method that use directional antenna; masking that use GPS to electric wave Direction Finding method. In this study, detect direction of electric wave to use shielding Effectiveness.

First, use iron to cover data. One part opens in steel box of cylindrical. One part of steel box opens and electric wave enters a company to this opened part and almost most return in remainder segment. Mask main board of system that is installed inside vehicles using steel box and electric wave resend from user's remote control checks reception number of times by (in east, west, south, north) by each direction.

There are a lot of reception frequencies in frontage direction of steel box, and most electric waves by shielding Effectiveness return in remainder direction and reception number of times is small.

System that is installed inside vehicles informs user end product analyzing this reception frequency. User confirms that direction (east, west, south, north) of parking vehicles through LCD of remote control and confirms the positions by assistance compass, which is attached together.

3.3 Circuit Design

Microprocessor used on controlling means of all systems chooses MICROCHIP Company's PIC16F873 and controlled RF communication, DC motor control, electron compass module etc. Communication between vehicles and user is achieved using two-way RF module, and gains attach large LMR antenna and used for extension of communicating distance.

The problem that it is necessary is coordinate of the user and the vehicle in the development of location recognition system. From this subject, it got the data to be easy and the control selected an ease one electronic compass module for the solution of that problem. The using specific data of each direction controls opening direction of steel box, and it gives user the data of location of parking vehicle.

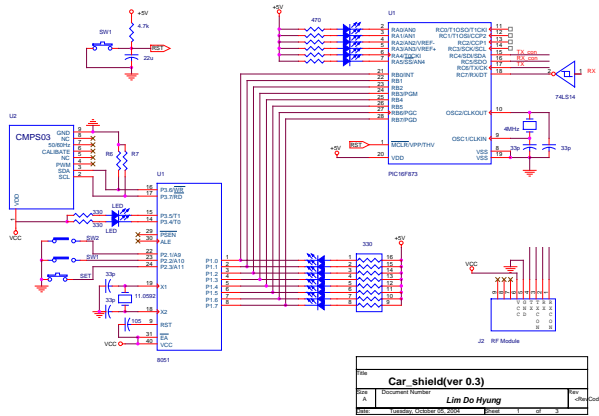


Figure 4: Electric compass and RF module controller

4. The test result

It uses the shielding effect of the electric wave with direction finding method of the electric wave, and it checks count of reception that data, which is, transmitted from the user remote control each direction. Shielding steel box receives a data from module of the electronic compass, and it catches an opening direction (not shielding) initially to the north. The opening direction rotates in Oder to North - East - South - West - North, and the steel box is received the period electric wave still 3.5 seconds while 5 seconds at each direction. Some transmission of a data(0x6a) transmits continuously with the delay of 50ms. Because direction of one side receives for 3.5 seconds.

$$3500ms = 50ms * 70 \text{ times}$$

The maximum of the receipt of a data is 70 times.

At first when the main board of system (fastened vehicle) doesn't shielding the shielding with steel box, when user nears by vehicle also the receipt of 69 times in all of the direction. That is, when near direction don't show up shielding-effectiveness, so direction-detection of an electric wave is unsuccessful.

Table 1. When user standing west

| Times | North | East | South | West |
|-------|-------|------|-------|------|
| 1 | 66 | 8 | 68 | 69 |
| 2 | 64 | 56 | 69 | 69 |
| 3 | 67 | 59 | 69 | 38 |
| 4 | 65 | 57 | 69 | 60 |
| 5 | 69 | 41 | 68 | 53 |
| 6 | 60 | 36 | 69 | 69 |
| 7 | 65 | 7 | 68 | 69 |
| 8 | 46 | 6 | 65 | 16 |
| 9 | 66 | 60 | 69 | 68 |
| 10 | 69 | 32 | 69 | 52 |
| 11 | 69 | 46 | 69 | 68 |
| 12 | 67 | 26 | 68 | 68 |
| 13 | 69 | 57 | 69 | 42 |
| 14 | 68 | 68 | 68 | 67 |
| 15 | 63 | 23 | 69 | 37 |
| 16 | 69 | 36 | 70 | 49 |
| 17 | 69 | 50 | 69 | 52 |
| 18 | 69 | 25 | 69 | 60 |
| 19 | 68 | 58 | 70 | 62 |
| 20 | 69 | 13 | 69 | 68 |
| 21 | 68 | 50 | 69 | 58 |
| 22 | 63 | 59 | 69 | 51 |
| 23 | 69 | 20 | 69 | 67 |
| 24 | 69 | 18 | 69 | 69 |
| 25 | 69 | 59 | 69 | 69 |
| Ave | 66.2 | 38.8 | 68.72 | 58 |

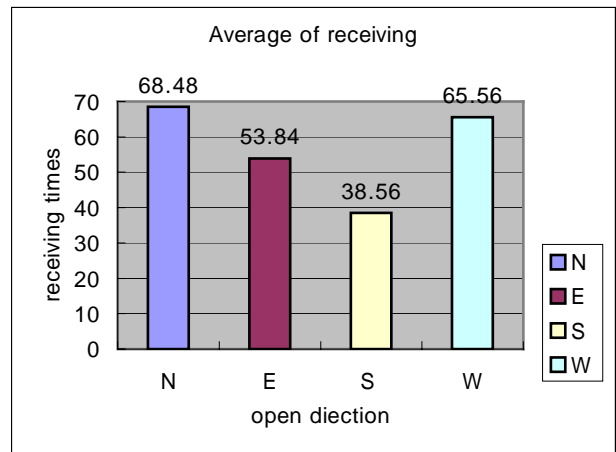


Figure 5: When user standing west, average receipt of radio wave

Table 2. When user standing North

| Times | North | East | South | West |
|------------|-------|-------|-------|-------|
| 1 | 69 | 58 | 59 | 68 |
| 2 | 69 | 60 | 26 | 68 |
| 3 | 69 | 62 | 35 | 69 |
| 4 | 69 | 39 | 24 | 69 |
| 5 | 69 | 64 | 31 | 51 |
| 6 | 69 | 56 | 45 | 69 |
| 7 | 69 | 69 | 54 | 69 |
| 8 | 69 | 69 | 30 | 69 |
| 9 | 69 | 58 | 42 | 69 |
| 10 | 69 | 46 | 35 | 69 |
| 11 | 64 | 32 | 35 | 69 |
| 12 | 69 | 65 | 51 | 67 |
| 13 | 69 | 49 | 45 | 68 |
| 14 | 68 | 44 | 3 | 68 |
| 15 | 69 | 56 | 58 | 69 |
| 16 | 65 | 18 | 11 | 58 |
| 17 | 68 | 54 | 40 | 58 |
| 18 | 70 | 55 | 14 | 32 |
| 19 | 68 | 68 | 44 | 68 |
| 20 | 69 | 64 | 62 | 69 |
| 21 | 69 | 65 | 66 | 69 |
| 22 | 69 | 65 | 67 | 69 |
| 23 | 68 | 44 | 40 | 68 |
| 24 | 68 | 32 | 8 | 69 |
| 25 | 69 | 54 | 39 | 68 |
| Ave | 68.48 | 53.84 | 38.56 | 65.56 |

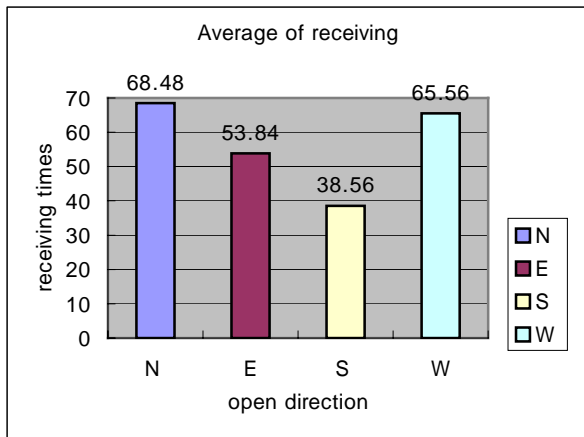


Figure 6: When user standing North, average receipt of radio wave

When it tries to observe a test result, direction of the electric wave, which it transmits from the user remote control from same direction it even, records a most small reception Hoes possibility, using this data, it is a possibility of searching the location of the parking vehicle. From direct opposition direction of opening direction, because the car cover material reflects the electric wave of most, Work records a reception

Hoes possibility; from different direction it recorded a numerical figure near most maximum reception Hoes possibility 70. Namely, location of the vehicle, which the user searches, becomes the direction, which shows a most small reception Hoes possibility.

5. Conclusion

This system present the method that uses an electric wave shielding effect for parked vehicles searching in big parking lot or wide area. Shielding material made of iron, through analysis of the electric wave (by classification of direction) in forms the location of parking vehicle. Following will the function of this system and it will be able to augment the use characteristic of the product. Also the use is possible between form the urge interior parking lot where the reception of GPS is weak. More see the situation of the parking lot which has the structure which is complicated the location grasp against a hereafter height must become accomplished and the location grasp of the parking vehicle which is quick and accurate will be necessary.

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