

Dedicated Humanoid Robots for Road Traffic Safety

A Brief on Idea, Design, Production, Commercialization and Applications

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I. Description of Idea

I.1. Title of the idea

Economic, commercialized and dedicated humanoid robots for road safety applications.

I.2. Why is it new and useful?

General humanoid robot is a long term subject in robotic community. In addition to its complexity; everyday application of this kind of robots is very complex. On the other hand, Increasing road safety and traffic control is one of the important subjects in all countries. Using of humanoid robot for road safety provides two main benefits, one for whole of the community who or their relatives or friends drive and next for increasing the quality of work and safety situation for road policemen and road safety workers while if it can be economic product. Fig (1) is a sample of real safety officer and Fig (2) indicates our products, have introduced in an exhibition (Road Safety and Injuries Ex.06-Tehran).



Fig. (1) Real Safety Worker – Idea



Fig. (2) Produced Products

II. Description of Products

Due to the applications we produced two products.

1. Road Safety Flagger Robot with motion detection and alarm notification capability
2. Road Police Robot with speed measuring and video capturing capability

II.2. Description of Road Safety Flagger Robot (Price has been 755Euro)

This robot can be used as a safety worker or as a flagger worker in road constructing or repairing places for temporary or long term application. This robot is a simple humanoid robot which informs the moving objects (Including Cars, Bicycles, Motorcycles, and Pedestrians) from the existence of a dangerous condition in road or around it. It's a portable robot with only a simple image processing unit (motion detection features), simple two degree of freedom arm and features for playing recorded alarm tones. It can be used 7days/24 hours a week as a road safety worker with less than \$1500 price. Which is a very reasonable price regarding the salary of safety workers. Fig (2) yellow robot is this robot. The robot is used as road safety workers by some Iranian road construction contractors and Iran road and transportation ministry-division of road safety. Some other companies have used the robot as a safety worker in their digging places. For this product our motto is simple, economic and effective.

II.2. Description of Road Police Robots (Price has been 2950Euro)

Traffic control with safety cameras and road signs produces limited performance. Reports and everyone experiences prove that using a policeman will provide better result. Under police supervision and traffic controlling drivers try to drive in a safer manner. But there are limited human/financial resources for implementing this quality of safety with real road policemen. On the other hand traffic control is simple but it is not safe. So using real policeman for road safety and control for 7day/24 hours a week in all weather conditions would be expensive (impossible) and dangerous. We think that we solved this problem with our robot with at least 20% improvement of safety comparing to speed camera. This product is like the first robot but it has some features for road traffic controlling. So totally it works like the safety robot, and following features included in.

1. Moving Object/Vehicle Detection (Motion Detection and Video Segmentation)
2. Speed Detection System (Inter frame Object Scaling Calculation for Speed Estimation)
3. Image and Video Capturing System
4. Software which records following information
 - 4.1 Number of Cars
 - 4.2 A picture of a car which has a speed more than speed limit
 - 4.3 5Sec video from the car which has a speed more than limit

So in road, where the robot is placed; when it sees a moving vehicle has a speed more than a defined limit, at the distance of 150 m, it moves its arm (which holds slow down sign racket). If driver decrease the speed, it will stop, but if doesn't; robot flashes a light and captures a high resolution image and 5Sec medium quality video at 75 m, and it complete following record.

Robot ID	Date	Time	Speed Limit	Detected Speed	High Resolution Image	5Sec video
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The information is recorded on a portable memory which can be used by police officers to check history of unsafe drivings. Several other options have been placed for this robot but their commercialization was not successful, we found that only the general police robot with minimum price and simple safety and traffic control features would be most successful product.

Fig.(3) and (4) indicated the application of these two products.



Fig. (3). Robot along a highway front of police kiosk.



Fig. (4). Workshop that we produced the robots

II.3. Mechanic and Hardware Description

II.3.a. Mechanics Structure

The body includes two separate parts, that can be easily assembled at manufacturing or maintenance phase Fig.(5). For easy transportation legs (telescopic joint with up side of body) so can go inside the body up to shoulder and robot can be placed in a small car Fig.(6).b



Fig.(5) Up and down part of the robot

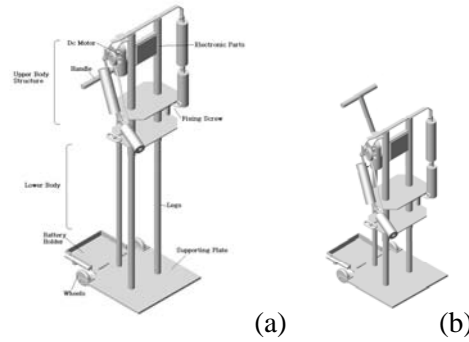


Fig.(6) Normal and compressed forms of the robot

II.3.b. Hardware

Three sections have been used in hardware, the first section is image processing base data measurement unit which detects motions, calculates speeds, and captures images and videos. This section works with robot controller and takes the command from it and delivers the result for it (Speed, Detected Motion, Captured Image and Video).

The second section is robot controller is a microcontroller for handling all the necessary control and management functions including control on 2DOF arms, playing recorded sounds or alarms, controlling light flasher, positioning side of the racket (stop sign, slow down or driving new sign for LED matrix display). The controller drives a SD memory card (2GB) to save records of received information from image processing system. Image processing system is placed in robot head, the imaging lenses are placed in robot eye Fig.(9). The control hardware is placed inside robot body. Lighting and flasher is mounted on the top of head, charging circuit and battery is behind of foots.



Fig. (7) Positioning



Fig. (8) Hardware



Fig. (9) Schematic of Hardware

II.3.c. Power

Third section is power circuit; Power supply can be direct AC electricity redundant with a rechargeable 12v/48Ah lead acid battery with complementary recharging circuit. This battery plays the role of stabilization of the robot under windy conditions which is a very important factor (because it is a robot with 180cm height) Fig. (7). an optional solar panel has been considered for products as well. So three possible electricity sources, make the product be applicable everywhere, even far from cities. If the battery is charged then the robot can work with it up to 42 hours.

II.3.d. Body and Clothing

Because of the importance of having a real safety police or worker, the robot must look like a real human as much as possible, so we used a plastic body with very natural face for our robot, which provides three main benefits. First provides similarity to human body and its result from psychological view. Second makes water proof (the robot needs to be applicable on any weather for example rainy conditions). Finally it helps to stabilize robot because it

makes upside light and produces less destabilizing torque. Robot have a water proof underneath and a washable clothing on top of that.

III. Description of Applications

Every where that a safety worker notifies other moving objects (humans, vehicles, ...) from a possible danger, these products can be used, so in all highways, road working places and dangerous spots they will provide 7 days/24 hours a week applicability. But the best applications that the idea has been used are.

1. Road Safety Flagger, In road construction or maintenance project
2. Road Traffic Control, In highways and freeways
3. Municipal contactors for water, phone, electricity and gas distribution projects, these contractors normally use the product in their digging (long term and short term) workplaces in cities where people don't expect a dangerous situation.

So in each of these applications our robot has been used and tested.

V. Novelty/Uniqueness of Product

We haven't found any company which produces our product "Economically dedicated humanoid robot for road safety". We produced an economic product that any customer can buy. We patented the idea in IP office in Iran (nationally) and in UK IPO (internationally) which shows the novelty of the product. From entrepreneurship aspect we won two times the first rank in national entrepreneurship festivals between all other industries (not just the robotic industry) which means that the idea and the results were great for award committees.

The other important thing, from human being view is that; we produced a product which helps and decreases one of the worst issues in the world. 'Road accident injury and death and we increased the people safety', which is the best part of our work. This subject is the key that UNESCO awarded us the international prize and certificate which we love it.

VI. Market Analysis, Economic Viability and Pathway for Commercialization

After introducing these robots; we presented them for Iranian road police and road - transportation ministry, they initially didn't accept to use them but after a month they came to us and we sold more than 100 robots. Additionally we found some non governmental customers from road contractor community. After first introducing the product in Iran we needed time to document the idea and the results, so we presented idea in some ITS conferences nationally and internationally (they were accepted). At the moment we are trying to make the products more powerful and more functional, while we are trying to introduce our product in Dubai and Australia.

The product is completely economical because its price is less than one month salary of a safety worker in one working shift (less than \$855 for a robot). Business plan of the product determined that in Iran we can have more than 150 yearly. And we reached to 100 sold out.

On the other hand we aren't a big company or research center with unlimited financial resources. We were only two brothers (less than 31 and 25 years old) who managed all scientific research, design, manufacturing and commercialization of the idea with our limited resources (less than \$40,000 initial investment and 4 years work). And off course we don't mean that we have built a perfect system, but from entrepreneurship view, we produced an effective system form advanced and high technology with our resource and accepted the probable risks. In last two years (in UK, IRAN, UAE and Australia), we found some companies they were interested on investing on the idea but we was waiting for patent result which was published in Dec2008. We think comparing this work with other works of big companies and big research center outputs is not fair. But from novelty and entrepreneurship the work was perfect.

VII. Sustained Competitive Advantage

- 1.The road safety is a problem for all countries, everywhere and every time.
- 2.We have done all the design, manufacturing and researches ourselves which means that we are not depend to any body. How ever after the introduction we used some outsourcing concept to increase the quality, decrease time and required investment for manufacturing the mechanical parts. We used all the possible vacant in our family which provide a friendly environment for our small company.
3. From our point of view, it is not only a financial idea. It’s a kind of interest, human being and research.
- 4.No body produces same robot in Iran and any where in world.
- 5.We documented the idea and results in national and international organizations.
- 6.At the moment with Deakin scholarship we are doing our research, Ph.D. which will help us for further research and more scientific functions.

VIII. The Experimental Results of Robot Applications

Further more of increasing safety and 7 days/24 hours a week working capability for replacing real safety workers or policemen. Using this idea decreases average speed of cars by 14.6%, and decreases the distribution standard deviation by 27.8%. This means that drivers have tried to drive safer not just slower. Therefore the products completely succeed to force drivers to obeying the desired driving behavior. Fig (10) and (11) shows distribution of cars speed before and after the installation of the robot. The curves show the influence of the robot on vehicle with high speed. The interesting result is that the left half of the curves was pretty same but the right half has been changed. We described this subject in our publications.

The price depends of the robot features from \$1500- \$6000 and if we use this on dangerous points, due to Iranian police report from the registered accidents we improved safety by 23%. Considering that achieving the same results by other factors (Road, Traffic Control and Training) will cause more costs and need more recourses. Which makes them impossible and 23% means at least 23% decrease in death and injuries, 23% direct financial costs and ...

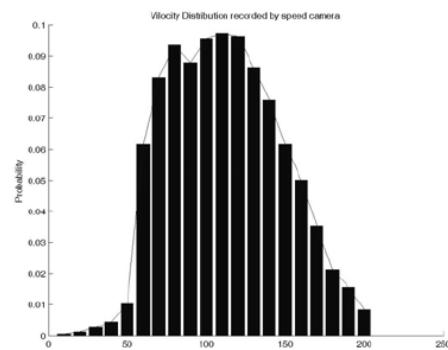


Fig. (10) Speed Camera Results Distribution of Cars Speed

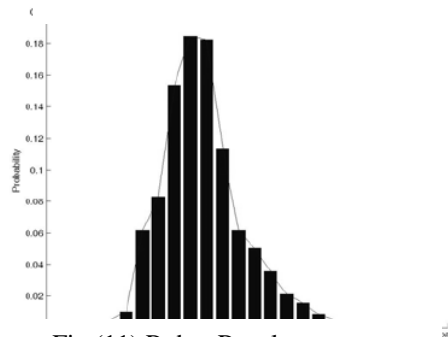


Fig (11) Robot Results Distribution of Cars Speed

Comments

Please be advised that we are not a big research company with unlimited financial supports, we are only two brothers, who studied masters on control and electronic engineering at the best Iranian university and we did all the things with our limited budget.

Due to limit of applications further information catalogs, certifications will be presented in the case of enquiry. So please just inform me for any other information from Videos, Pictures, Drawings, Patents, Certificates, Awards and Contracts.

Golden Medal



UNESCO Certificate



Published Patent

