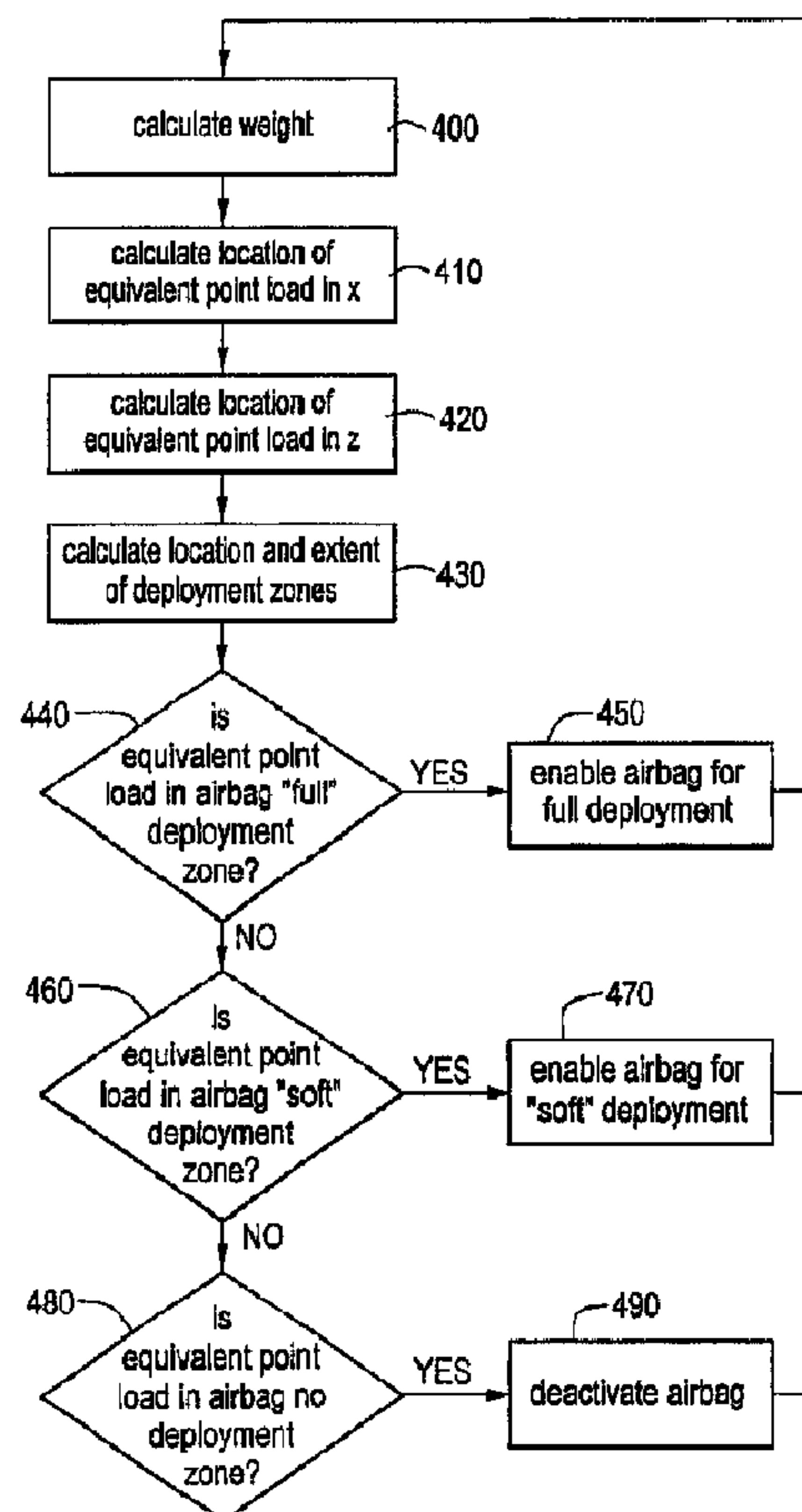




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(21) International Application Number: PCT/US98/00454 (22) International Filing Date: 6 January 1998 (06.01.98) (30) Priority Data: 08/780,435 8 January 1997 (08.01.97) US (71) Applicant: TRUSTEES OF BOSTON UNIVERSITY [US/US]; 147 Bay State Road, Boston, MA 02215 (US). (72) Inventors: BURKE, Shawn, E.; 39 Kathleen Drive, Andover, MA 01810 (US). HUBBARD, James, E., Jr.; 61 Drew Woods Drive, Derry, NH 03038 (US). (74) Agents: GAGNEBIN, Charles, L., III et al.; Weingarten, Schurgin, Gagnebin & Hayes LLP, Ten Post Office Square, Boston, MA 02109 (US).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>With amended claims.</i> Date of publication of the amended claims: 20 August 1998 (20.08.98)

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CENTER OF WEIGHT SENSOR

BACKGROUND OF THE INVENTION

This invention relates to the field of sensors, and particularly to a sensor architecture preferably utilized in a vehicle airbag control system which determines the weight and two dimensional spatial location of an equivalent point load as representing the passenger. The location and weight of the passenger are used to construct airbag firing zones which determine whether and how the airbag will deploy.

Frontal airbags are now a standard feature in most modern automobiles. The recent trend in modern airbag design is moving towards sophisticated systems that implement energy management, *i.e.*, the application of less than 100% of the airbag's potential cushioning force upon deployment of the airbag. It has been desirable for some time to manage the speed of the airbag's deployment based on factors such vehicle speed, intensity of the collision, and passenger weight. Until now, such objectives have not been achieved.

It has been for some time the goal of design engineers to manage the energy of the deploying airbag so that they deploy at variable rates ranging anywhere from less than 50% of the potential cushioning effect of the airbag to 100% of the cushioning effect of the airbag. These considerations are important inasmuch as the characteristics of the driver or passenger may range in weight from a small infant to a large adult.

Today's airbags deploy at only one rate: 100% force. Typically, airbags are deployed at speeds approaching 200 m.p.h. An object or passenger struck by an airbag inflating at such speeds absorbs forces approaching 2500 lbf. In order to be deployed at anything less than 100% force, there is a need for more intelligent, highly integrated, low-cost, high performance electronic sensor technologies.

Under ideal firing conditions, the airbag should fully deploy or be nearly fully deployed before the passenger's body moves forward as a result of the accident so that the force of deployment is not absorbed by the occupant. In practice, however, the airbag often strikes the vehicle occupant before being fully deployed. This is due to the fact that each passenger in a vehicle, whether the driver or otherwise, assumes a unique ergonomic

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position and are of different sizes and weights. Vehicle occupants who are tall usually adjust their seats rearwardly and may even recline their seats. This creates an ideal body position for purposes of complete airbag deployment inasmuch as the passenger will likely not be struck by the airbag while it is deploying.

5 In the case of shorter passengers, on the other hand, the seats are often adjusted forward, placing the passenger in the firing zone of the airbag. Likewise, when the passenger is an infant or small child in a rear facing child seat, the deployment of the airbag often causes a violent collision and subsequent rearward force applied to the backside of the seat.

10 Furthermore, the weight of the occupant is an important factor in the ability of a child or small adult to sustain the trauma delivered by airbag deployment. Children and small adults are particularly susceptible to injury not only due to being situated in the zone of the deployment, but also as a virtue of their size they are unable to sustain the large impact force delivered by the airbag.

15 In order to evaluate whether an individual is situated in the firing zone of an airbag, or whether, given the weight of the individual, the deployment of the airbag would cause more injury than non-deployment, "smart" sensors are needed. However, to date, no such sensors are commercially available which are capable of providing both a means of continuously determining whether a vehicle occupant is positioned in the airbag
20 deployment zone and the weight of the occupant.

These and other problems are sought to be overcome by the invention of the preferred embodiments.

SUMMARY OF THE INVENTION

25 It is an object of the present invention to provide a sensor system capable of taking a distributed load and reducing it to an equivalent point load in two spatial dimensions.

It is a further object of the present invention to provide a sensor system capable of determining the weight of the distributed load.

30 It is a further object of the present invention to provide a sensor system capable of continuously updating the position of the equivalent point load under both static and dynamic operating conditions.

