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Non-wearable Fusion Sensors System with AI for Detection of Cognitive Workload for Pilots and Controllers

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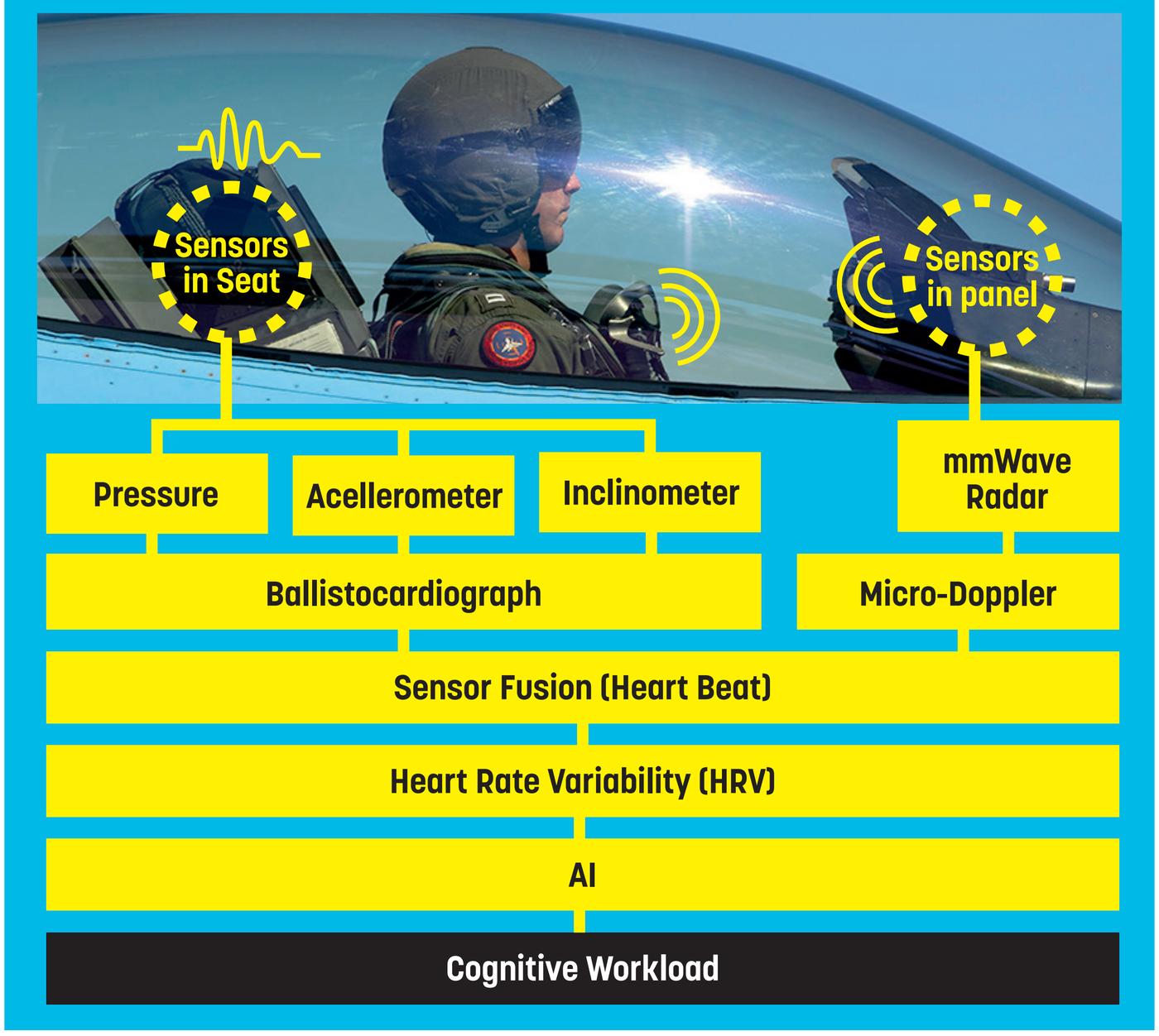
Abstract

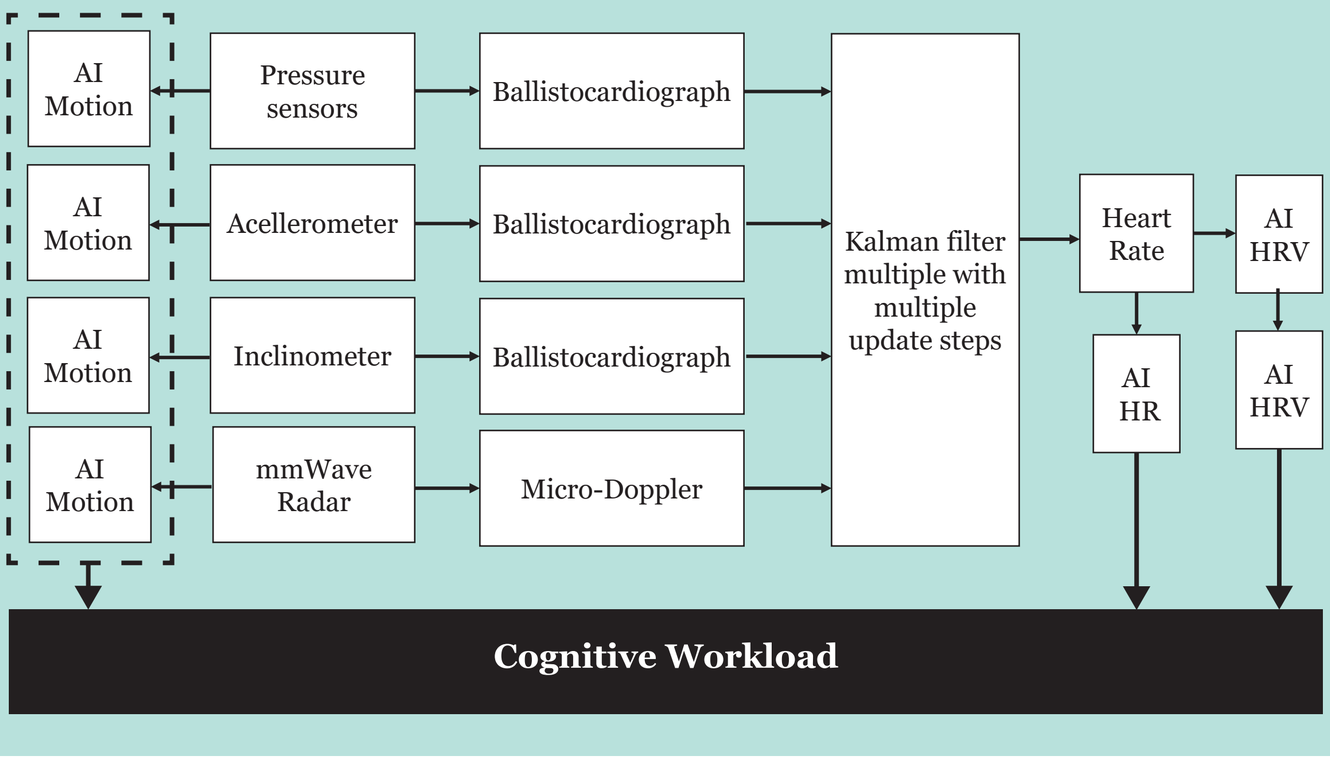
This proposed work presents a resilient system of sensors to measure vital signals and motions using sensor fusion techniques and AI to identify cognitive workload and abnormal cardiac signs of pilots and controllers without wearing any wearable device.

To measure the heart rate and breathing rate of the pilot and controllers sitting on a seat were used two types of sensors were for obtaining the heart rate using the Ballistocardiograph (BCG) technique [1]: pressure sensor based on the electromechanical film (EMFs) and high-precision accelerometer sensors based on microelectromechanical (MEMS). These sensors were positioned on the seat, without pilots or controllers wearing anything. A non-contact mmWave radar sensor was used to obtain the heart rate [2] using Micro-Doppler techniques [3] to avoid wrong measures from the unwanted movements in the seat. The heart rate (HR) and respiratory rate (RR) are obtained and analyzed together with heart rate variability (HRV) as variables in the workload identification [4]. This information is then sent to an AI system trained to identify fatigue, cognitive workload situations, and health issues. All this redundant and persistent information feeds a data fusion algorithm based on Kalman filtering [5], which makes the information more resilient and conident.

Graphical Abstract

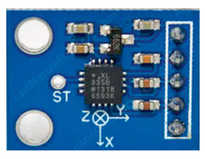


General Diagram

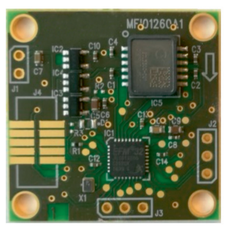


Sensors

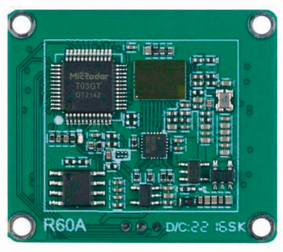
Pressure Electromechanical film



Acellerometer MEMS



Inclinometer MEMS



mmWave 60 GHz Radar

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