US011609543B2

(12) **United States Patent**
Tomanovic et al.

(10) **Patent No.: US 11,609,543 B2**
(45) **Date of Patent: Mar. 21, 2023**

(54) **SAFETY NETWORK CONTROLLER REDUNDANCY IN AN ELECTRONIC SAFETY SYSTEM**

(71) Applicant: **Ring Bus Americas LLC**, Ann Arbor, MI (US)

(72) Inventors: **Uros Tomanovic**, Belgrade (RS); **Dejan Teofilovic**, Ann Arbor, MI (US)

(73) Assignee: **RING BUS AMERICAS LLC**, Ann Arbor, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 351 days.

(21) Appl. No.: **17/076,199**

(22) Filed: **Oct. 21, 2020**

(65) **Prior Publication Data**

US 2022/0121166 A1 Apr. 21, 2022

(51) **Int. Cl.**
G05B 19/042 (2006.01)
G05B 19/05 (2006.01)
H04L 1/22 (2006.01)

(52) **U.S. Cl.**
CPC ***G05B 19/0428*** (2013.01); ***G05B 19/052*** (2013.01); ***H04L 1/22*** (2013.01)

(58) **Field of Classification Search**
CPC .. G05B 19/00; G05B 19/048; G05B 19/0428; G05B 19/052; H04L 1/22
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0222112 A1* 9/2009 Moddemann H04L 12/40006 700/79
2010/0145475 A1* 6/2010 Bartels G05B 15/02 700/79
2016/0139999 A1* 5/2016 Gabler H04L 45/28 714/4.11
2019/0302730 A1* 10/2019 Ueda G05B 19/0425
2020/0133243 A1* 4/2020 Scheible G05B 19/4184
2022/0050451 A1* 2/2022 Stay G05B 19/41835

FOREIGN PATENT DOCUMENTS

EP 2149830 A1 * 2/2010 ..... G05B 19/4063
EP 3547049 A1 * 10/2019 ..... G05B 19/0423
EP 3599521 A1 * 1/2020 ..... G05B 19/0423
JP 2011090675 A * 5/2011 ..... G05B 19/0426
JP WO 2022239116 A1 * 11/2022 ..... G05B 19/048
WO WO-9322151 A1 * 11/1993 ..... B60L 3/12
WO WO-2018139627 A1 * 8/2018 ..... G05B 19/058

* cited by examiner

Primary Examiner — Ronald D Hartman, Jr.
(74) *Attorney, Agent, or Firm* — Coats & Bennett, PLLC

(57) **ABSTRACT**

A safety network controller is comprised in an electronic safety system. The safety network controller comprises a first serial port and a second serial port, each of which is configured to communicatively connect to a redundant safety network controller via a respective daisy chain network. Each daisy chain network comprises at least one safety device controller that is controlling a corresponding safety device. The safety network controller further comprises network circuitry configured to communicatively connect to the redundant safety network controller via a packet-switched network. The safety network controller further comprises processing circuitry configured to exchange, with the redundant safety network controller: serial communication via each of the daisy chain networks; packets via the packet-switched network; and responsibility for control over one or more of the safety device controllers in response to detecting a failure.

30 Claims, 14 Drawing Sheets