DESIGN OF A MOBILE RFID READER SYSTEM WITH CLOSELY PLACED ARRAY AND ITS APPLICATION TO SEGWAY VEHICLE

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ABSTRACT

The radio frequency identification (RFID) technology with contactless object identification is essential for a wide range of industrial applications, including manufacturing, logistic, retail, warehouse and so forth. Amongst different operating frequencies, ultra-high frequency (UHF) RFID operated from 920 MHz to 925 MHz is attractive and it is still in growing of importance. Using backscattering communication, the read/write function between the object and the reader is realized in relatively long distance.

In this thesis, we intend to enhance object detection capability, smart antenna technique is thus studied. The phased array antenna is adopted, which not only extends the coverage by enhancing the antenna gain of the radiating beam, but also provides the beam steering capability to RFID readers. A 4-element Quasi-Yagi antenna array operated at 920 MHz is thus implemented, with flexible phase shift control by software leading to 40˚ beam steering controllability. Incorporating the developed antenna system with Segway vehicle, a mobile RFID item management platform is demonstrated.

It is well known that the array antenna suffers from the mutual coupling problem when they are closely placed, a simple and systematic decoupling network using parallel coupled-line (PCL) is thus proposed, and three types of PCL structure with open-ended, short-ended with capacitors loaded and inductors loaded are theoretically analyzed. At the center frequency of 920 MHz for UHF RFID, a design example for two closely coupled Quasi-Yagi antennas using open-ended PCL is designed and experimentally characterized, the port isolation has around 15 dB improvement compared with the uncoupled situation in the measurement. Besides, the port decoupling demonstrates a notable improvement of received signal strength indicator (RSSI) for single and multiple tag detections.
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LIST OF ABBREVIATIONS

RFID  Radio frequency identification

PCL   Parallel coupled-line

ISO   International organization for standardization

IEC   International electro technical commission

EPC   Electronic product code

ETSI  European telecommunications standard institute

ERP   Effective/Equivalent radiated power

EIRP  Effective/Equivalent isotropically radiated power

ASK   Amplitude shift keying

MCU   Microprocessor Unit

RSSI  Received signal strength indicator

DAC   Digital-to-analog converter

CPW   Co-planar waveguide

PIFA  Planar inverted F antenna

SRR   Split ring resonator

DGS   Defected ground structure

SPI   Serial peripheral interface