Design and Development of UHF RFID Reader Antenna for Livestock Monitoring

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Abstract—This paper presents a circularly polarized E shaped microstrip single layer patch antenna with parasitic element for the reader of the UHF RFID livestock monitoring system. The antenna is designed to operate at a frequency of 919 MHz to 923 MHz allocated for UHF RFID systems in Malaysia. The antenna simulation is analyzed using CST Studio Suite 2013 based on Finite Integral Techniques (FIT). In order to ensure the design is in good performance, all of the antenna parameters are optimized using Quasi Newton Method. The result show that this antenna is able to operate from 919 MHz to 923 MHz frequency bandwidth with optimum frequency at 918 MHz. Furthermore the result of antenna parameter such as radiation pattern, bandwidth, gain, return loss and voltage standing wave ratio are also discussed. The proposed antenna is lightweight, low profile, simple structure and easy fabrication.

Keywords—Microstrip Antenna, Frequency, Return Loss (S₁₁), Livestock, Computer Simulation Technology.

Radio Frequency Identification (RFID) is a modern term used to label a system that wirelessly transmits the identity of an object, using radio waves. These transmissions are of unique serial numbers, or codes. This is known as a contactless technology, whereby the tag or item does not to be manually touched or wired.

A reader (also called an RFID interrogator) is basically a transceiver that reads the content of RFID tags in the vicinity. The maximum distance between the reader's antenna and the tag vary, depending on application. In addition the role of antenna for reader and tag is very important. The antenna allows the chip to transmit the information that is used for identification. The RFID reader with circular polarized antennas radiate in a 90 degree pattern and are less sensitive to the tag's orientation on the package [1].

The first applications used in RFID system in livestock monitoring initially started only for identification purposes [2-3]. However, it has gained a growth potential exploration on RFID systems combined with sensors to create other advanced applications in animal rearing sections such as for monitoring the health status of a livestock, breeding climate changes and produced for handheld RFID reader such as helical antenna [10], loop antenna [11], PIFA antenna [12], monopole antenna [13] and three element printed Yagi antenna [14]. By adopting the same printed antenna methods as mention above, this proposed antenna design take advantages on FR-4 substrate material.

Microstrip antenna configuration consists of a dielectric substrate having patch geometry on one side and ground plane on the other side [15]. It has several advantages such as low weight, low profile, planer configuration, low fabrication costs and capability to integrate monolithic microwave integrated circuit (MMIC). Even the microstrip antenna comes with these advantages, in contrast, it also has a certain limitations as well, such as lesser gain, low bandwidth and low efficiency which affect the performance of this antenna [16]. Many researches are being done by the researchers to reduce these disadvantages by using different approach of patch geometry such as using E shaped patch [17], U shaped patch [18], L shaped patch [19] etc. Other methods to reduce these disadvantages includes the use of different thickness [20], use of substrate of dielectric materials, cutting various slots and notches in the patch geometry, antenna array [21] etc. for improving the performance which make this antennas have