UWB indoor localization system based on two-way ranging measurement for industrial applications

[Abstract for the Microsoft Indoor Localization Competition]

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Local positioning systems have been developing for years. Localization/tracking systems based on RFID technology are the most commonly used in the industry. Some experiments are being made with the use of the RSSI signal processing. Recent solutions based on UWB technology [1] enable a significant improvement in the precision of distance measurements. The positioning accuracy is a critical parameter especially for industrial applications designed to protect human beings working in the vicinity of vehicles. The initial goal was to develop a safety system that protects people working in the vicinity of forklifts. The solution presented in this study is the next stage in the development of the system. The original ELOshield system has been modified in order to achieve 2D and then 3D localization. The described system consists of four bases (UWB radio modules) and one mobile device. Localization is being done online and presented in graphical form on the laptop screen.

I. INTRODUCTION

The precise localization of objects in industrial environment is a difficult thing to do. In the case of radio systems, it is associated both with the presence of other sources of radio radiation as well as interferences associated with multiple reflection [2]. Equally important are constraints caused by objects between the transmitter and the receiver (e.g. metal structures, racks). The desired accuracy of the systems associated with the localization of people, should be better than 0,5 m. It is directly related to the size of the localized object, which is human being. Industrial safety system must also take into account a short time needed to respond to a potential threat to humans. The above-mentioned requirements were the basis for further studies related to the search for the best solution. Ultimately, this method consisting in the measurement of the radio signal propagation time has been selected for the implementation.

II. SYSTEM DESCRIPTION

The basic version of the system consists of four devices, which serve as bases, and mobile transponder. The principle of operation of the system has to take into account one transmission channel, which is shared by all devices. In the model solution, we have only one mobile device, but it is assumed that up to 50 devices will be working on the target system. In order to avoid the problems associated with mutual interference between the measurements, algorithm for the management of the channel access time has been implemented. The algorithm in the current version allows the segregation of access to measuring slots for each of the four bases.

Figure 1: Base node (left) and mobile module (right).

III. SYSTEM OPERATION

Calculating the position of an object in 3D space is based on a two-way ranging algorithm [Fig. 2]. Each B0-B3 base calculates the RF signal propagation time to O1 object. On the basis of the measured t0-t3 propagation time and the value of X1, Y1, Z1, the position of O1 object is calculated in the last

step. The results are presented in graphical form [Fig. 3]. Position of an object is calculated on-line by the same application. It is also possible to track an object in 2D space.

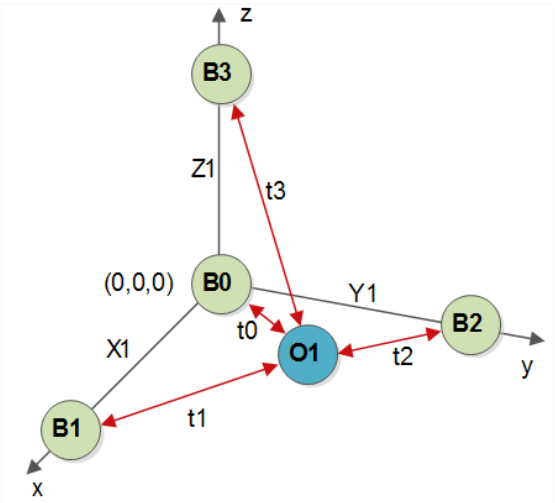

Figure 2: Two-way ranging in 3D localization system.

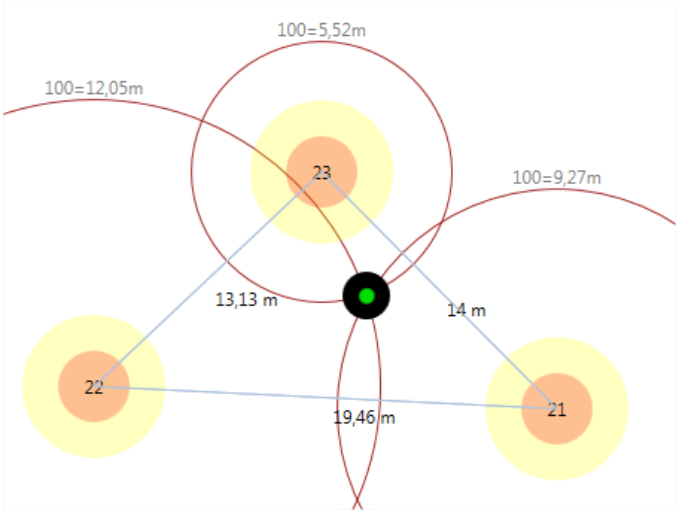

Figure 3: Online object localization.

IV. Conclusion

UWB has been recognized as a promising solution for the future to overcome limitations related to accuracy of the distance measurement. An UWB location system based on two-way ranging was introduced. Current state of positioning measurement and results were presented.

Future plans include performing a comprehensive measurement tests in the industrial environment.

References

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