

Thesis topic

English:

constructing and localization and Safety guidance model in underground installations

Polish:

Budowa modelu lokalizacji i ewakuacji w instalacjach podziemnych

Motivation

- There is no reference objects in underground installations (plants, horizon, sun). Corridors and chambers are almost identical, in particular if there is room-and-pillar extraction method used. Orientation worsens dust that combined from moisture deposit himself on a substrate, the walls and ceiling covering symbols describing the hallways.
- Miners do not have maps with themselves during their work. Maps are kept in Sztygarówka (supervisors place).
- Current safety regulations does not take new technology into account. Mines do not know where exactly their miners are. Personal safety equipment consists of oxygen masks enabling to survive 50 minutes, and lamps with GLON transmitter, allowing on detection from a few meters.
- European Union encourages to search for a good solution for the miners localization, which, in one of the postulates of its set of recommendations for the coal and steel sector ('Personnel Tracking' task). There are solutions for underground localisation but they allows only to approximate miner's position (error can be range from 300 m (range of a single radio receiver) to the distance to the next transmitter).
- This work is a response to the lack of a solution to aid the evacuation of a miner from a threatened area. As part of the work, presentations will be made of the positioning of underground systems, and a method of positioning in underground systems will be proposed, supported by measurements made during the test of the solution. Test will focus on stability, repeatability, accuracy and reliability factors. The work will discuss the mining model representation in terms of the location of the reference points, the location of the miner (system user), the safety points and the evacuation exits. The model should allow both the user to navigate to the nearest safety point, taking into account the current state of the corridors, and to allow presentation of the current position in graphical form. As part of the work, a complete model of the solution will be proposed along with the prototype of application for the mobile device. Finally, there will proposed future works that would base on a concept of integration of the location system with the function of remotely updating corridors. There will be provided example use cases.



Thesis scope

Environment model (representation of underground installation in computer memory)

- assumptions
 - The position of the mobile device will be determined by the environment model
 - The model is intended to enable the routing algorithm to be used
 - The model is supposed to be presented graphically
- Issues to discuss:
 - How to save a corridor model in computer memory
 - How to add to the model the reference points (beacons)
 - What features should have the model in order to be used in corridors visualization?
 - What features should have the model in order to be used for navigation?

Communication of the mobile device with reference points

- Assumptions and requirements
 - wireless communication
 - resistance to power outages and communications
 - Do I need the ability to change configuration of reference points (configuration of devices that perform role of reference points)?
 - What parameters can be read from the reference points (range, distance,?)
 - How long should the network work properly?
 - How to detect irregularities in reference points?
 - How to fix problems in reference points?
 - What problems may occur with points of reference?
- Review of available solutions
 - Bluetooth - the availability, supported by modern mobile technology,
 - ZigBee
 - other
- Issues to be discussed
 - Method of detecting reference points description
 - What are the possibilities to improve positioning on your mobile device?
 - How could the process of installing a localisation system in a mine look like?
 - How the parameters of the environment (corridor height, corridor width, type of rock, type of corridor corridors, presence of other networks operating on similar frequencies (WiFi, GSM (harmonic frequencies)), others) affect reference point signal quality.

Mobile application to help evacuate the underground installation

- Assumptions and requirements
 - Reading signal and its parameters from reference points;
 - Identification of reference points
 - Graphical presentation of the environment model (simplified in prototype version)
 - Current location presentation on the environment model

tests

- Position accuracy tests (for one, two, and more reference points)
 - using a representative wifi router, 801.11g technology, simple circular antenna (eg Minetronics MMG) - for charts.
 - using a representative beacon
 - dBm signal strength depending on the distance and polarity of the mobile device from the signal source
- Use case studies: fire, smoky corridor
- Use case studies: no electricity (dark, no ventilation)

