The 3rd TRIZ Symposium in Japan
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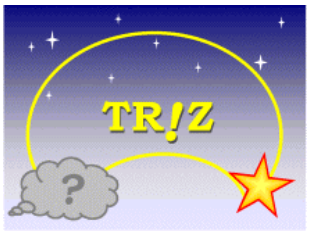

How to Prevent Unauthorized Persons from Entering the Auto-locking Door of Apartment Building: Applying TRIZ/USIT to A Social & Technical Problem

August 31, 2007
TOSHIBA Kenshu Center (Shin-Yokohama, Yokohama)

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Outline of our Talk:

Thesis work by Fujita (Mar. 2007) + Further research by Nakagawa.

To try to solve an everyday-life problem creatively.

'How to Prevent Unauthorized Persons from Entering
the Auto-locking Door of Apartment Building'

Such person can enter the door, simply by following a resident.

Not only technical but also human and social problem, in its nature.

We applied TRIZ/USIT in a smooth way.

Students' group discussions on issues guided with TRIZ/USIT.

3 Main Causes were found. -- We need to solve them all.

We propose a new Scheme/System of Auto-locking Door.

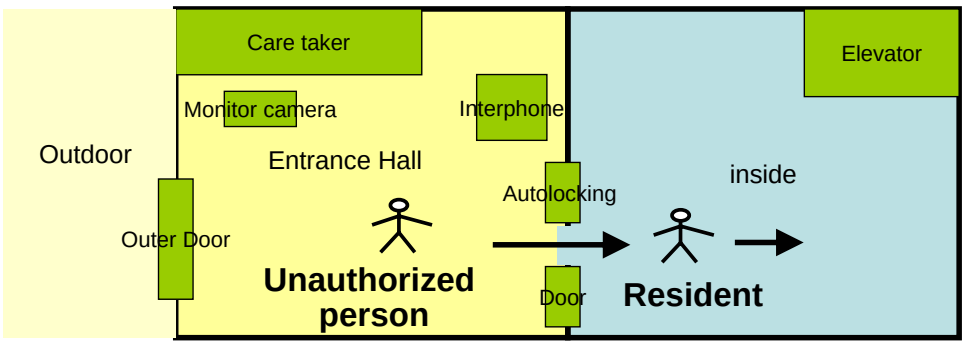
Primarily based on a solution in human psychology and social manner,
a clear technical solution ensures the security.

Problem Definition （with USIT）

(a) Undesirable Effect: In an apartment building with an auto-locking door system, unauthorized persons can enter the door easily and break the security.

(b) Task/Goal: To ensure the security of the apartment building by preventing the unauthorized persons from entering the auto-locking door .

(c) Sketch of the problem situation:



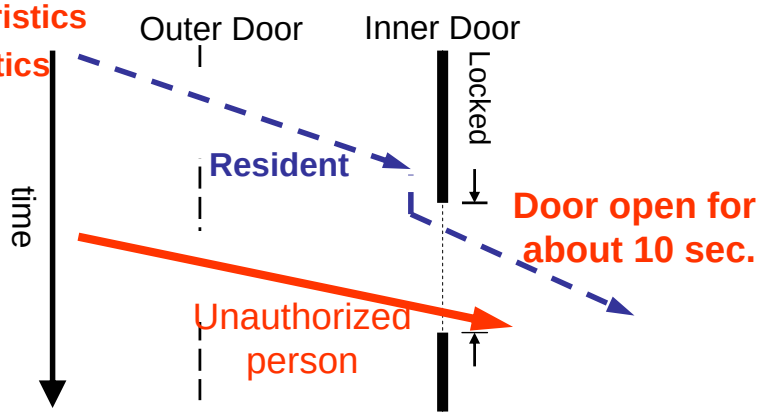
(d) Plausible Root Causes: The unauthorized person, behaving like a resident, can enter the door opened by a resident simply following after him/her.

(e) Minimum Set of Relevant Objects: Entrance door, Control system, an unauthorized person, a resident who goes ahead

Analyze the Problem（USIT, TRIZ, etc.）

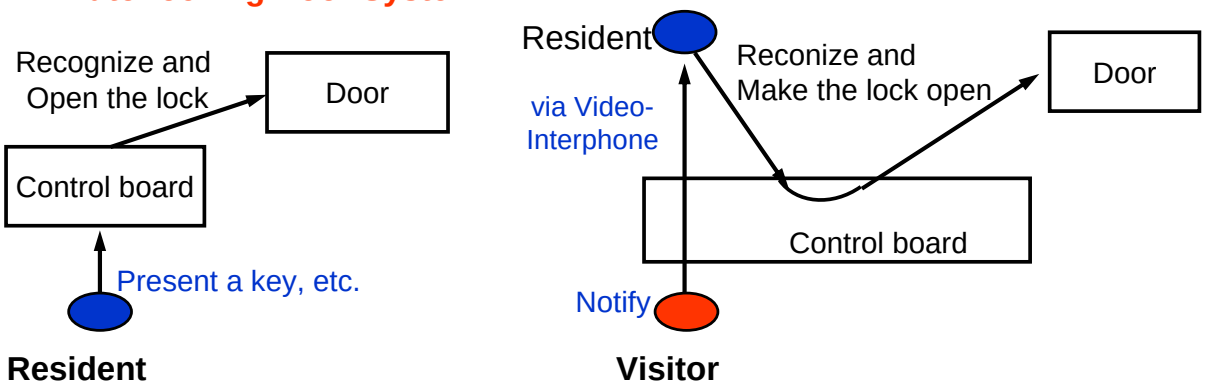
(a) Analysis of Space Characteristics

(b) Anlysis of Time Characteristics



(c) Current means:

Auto-locking Door System



(d) Analysis of Behavior of the Unauthorized [Subversion Analysis]

View from the unauthorized person

Discuss freely, and organize the recorded cards in the KJ method.

Unauthorized Person behaves just like a resident (pretending)

- in a costume/ attitude fit with the situation
- just like a student
- in an ordinary business ware
- just like a housekeeper

- disguise in a uniform of home delivery service
- saying 'package delivery service' or 'post-office express mail ' etc.
- disguise as if in the middle of a delivery service
- a sales person: try to access every resident via the interphone

Can slip in (at a good timing)

- follow a resident through the door in an innocent face
- Wait outside for a good timing
- Get a PIN in advance
- Watch and remember the PIN of a resident

Once get inside the door, one can go anywhere and can do anything

- Force a sale door-to-door
- Press the button of any floor in the elevator
- Unlock an apartment door with picking or a special technique.

(e) Analysis of residents' behaviors: Search for root causes in their psychology

Residents allow the unauthorized persons to get in.

We must be precautious against risks.

Because I thought he/she would be a resident.

- Becasue she looks like an housewife.
- Because being accompanied with a child
- Because she was carrying a shopping bag.
- Because I was in a hurry.

Because I didn't think he/she a malicious person

- We cannot recognize all the neighbors.
- Usually we do not think people malicious.
- I let the door unlocked because I did not doubt about his word.

Usually we assume our community being formed with good people in nature.

- It is a kind manner to hold the door open for a next coming person.
- It is a kind manner to hold the door open for a person having a big bag.
- In case of a heavy door, we hold the door open for a next person.
- In case of a light door or an automatic door, holding the door open is not necessary.

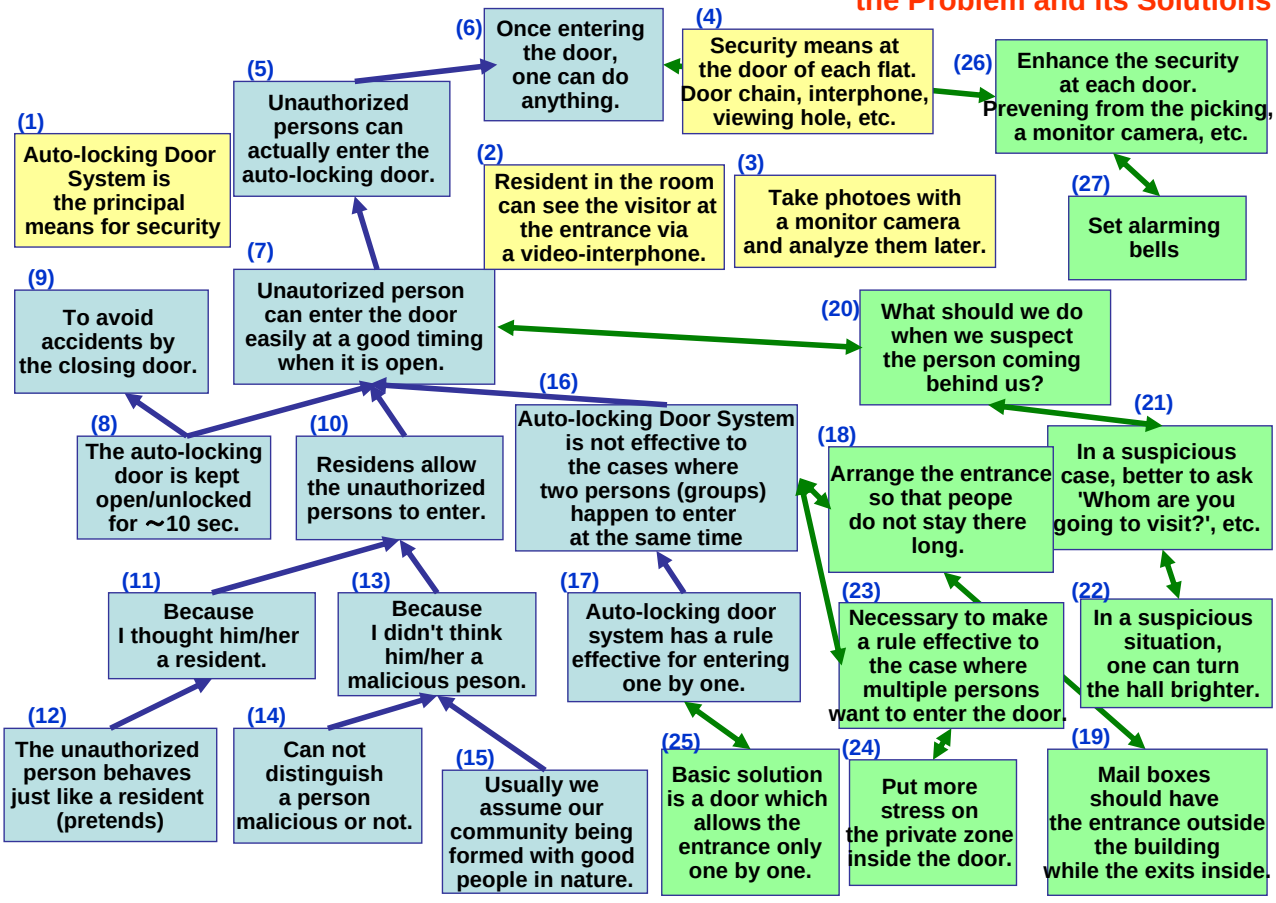
- In case we misjudge the person being malicious, we could be in trouble.
- The assumption of good people is a basis for a warm-hearted community.
- We do not want to be impolite and unkind to people.
- We will not block a person who happens to enter when we just go out.
- We will not stop a person who happens to enter next to us.

How to Prevent Unauthorized persons from entering the Autolocking Door of Apartment Building

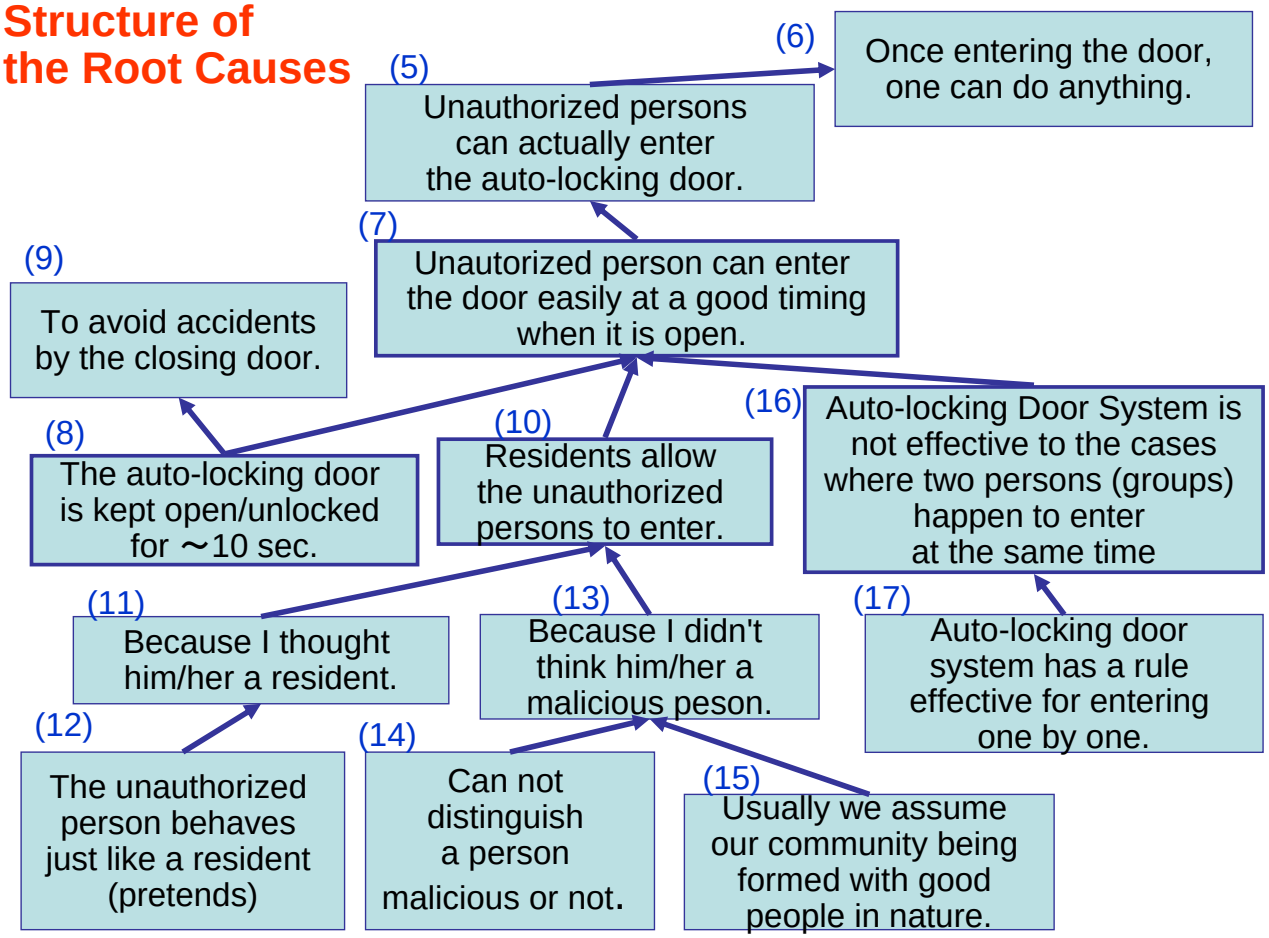
Collect the upper-level cards and put them in a glance to consider the logical relationships among them.

- Auto-locking Door System is the principal means for security
- Can not distinguish a person malicious or not.
- Take photoes with a monitor camera.
- What should we do when we suspect the person coming behind us?
- Mail boxes should have the entrance outside the building while the exits inside.
- Unauthorized persons can actually enter the auto-locking door.
- Can enter the door easily (at a good timing)
- Auto-locking door system has a rule effective for entering one by one.
- In a suspicious case, better to ask 'Whom are you going to visit?', etc.
- Residens allow the unauthorized persons to enter.
- The auto-locking door is kept open/unlocked for ~10 sec.
- It is not effective to the case where two persons (groups) happen to enter at the same time
- In a suspicious situation, one can turn the hall brighter.
- Set alarming bells which have switches in every flat and ring in the collidor of the floor and in the care-taker room.
- Because I thought him/her a resident.
- To avoid accidents by the closing door.
- Once entering the door, one can do anything.
- Necessary to make a rule effective to the case where multiple persons want to enter the door.
- Necessary for the resident in the room to see the visitor at the entrance via the video interphone.
- The unauthorized person behaves just like a resident (pretends)
- Because I didn't think him/her a malicious peson.
- Usually we assume our community being formed with good people in nature.
- Basic solution is a door which allows the entrance only one by one.

Increasing Security with the Auto-locking Door System: Overall Structure of the Problem and its Solutions



Structure of the Root Causes



Solving Problem (1) 'Residents allow the unauthorized persons to enter'

Clarify the principle that only the residents and authorized persons are allowed to enter the door.

Display more clearly: 'Private Zone'

Display and teach the basic principles simply and clearly.

Distinguish this from public doors which everybody may enter.

A resident who wants to enter ensures its company (by stating the number).

Do not give any convenience of entering to whom you do not guarantee.

'Kindness of holding the door open' does NOT apply here.

For entering the door, one has to state the number of persons (1 for default).

You do not need to judge whether he/she is a resident or not , and malicious or not.

'Accepting everybody' is NOT the rule here.

Teach and recognize that entering the door opened by other people is a violation of the rule.

You are not expected to suspect everybody.

Solving Problem (2) 'System is not effective when two groups happen to meet.'

Must clarify the rule
when two (or multiple) groups
happen to meet
in front of the door.

Display and teach
the basic principles
simply and clearly.

Each group is responsible
for getting authorized
by operating the key
(or something equivalent)

Even while the door is open,
System must be able to
accept the authorization procedure
by the next group.

Passing through the door
opened by a preceeding group
is a violation of the rule.

System should detect that
the next group is
likely to violate the rule
and make a notice immediately.

When you find the group
next to you is suspicious,
ask them 'Whom are you
going to visit?', etc.

System must detect
the violation by the next group
and make an alarm immediately.

Solving Problem (3) 'The auto-locking door is kept open/unlocked for 10 sec.'

To avoid accidents
by the closing door,
the big, heavy door should be
moved slowly and
operated on the safety side.

The number of people
who have passed/
are going to pass
should be detected
real time by an IT system.

Display and teach
the basic principles
simply and clearly.

Responding in real time,
proper displays and
announcements are made
for instruction and notice.

After the number of people
registered so far
have entered, display
'After getting authorized,
please enter the door.' etc.

With image pocessing,
the System determines
how many entered and
how many are likely to enter.

When more than
the registered number
are going to enter,
the System displays and
announces a notice.

Responding in real time,
displays, announcements,
alarms, photo recordings
are made with
increasing levels of alart.

To avoid the entering
from sides,
set poles and ropes
besides the door.

When more persons have
entered in violation,
the System
tells a warning and
takes a photo with lighting.

Records of alarm cases
are analysed later
systematically
to manage individually.

Solution: A New Control System of Auto-locking Door (Part 1)

(1) Display: "Private Zone Inside This Door."
"Residents and authorized persons ONLY are allowed to enter."

(2) Display: "Each person (or each group) should get authentication for yourself.
Even while the Door is Open, the authentication process is accepted.
Independent of the Door status, start the authentication process.
Entering the Door without authenication is a violation of the rule and law."

(3) Display: "Residents: Use the panel Left to the Door.
Visitors: Use the panel Right to the Door. "

(4) Display (on the Left Panel): "For Residents: Insert your key, Input the number of your group at moment (1 if you are alone), and turn and remove the key.

(5) Display (on the Right Panel): "For Visitors: Press the residence No. you are going to visit, and talk with the resident via the video interphone.
Get the approval by the resident, telling number of persons of your group.
When lamp(s) turn on for your group, please enter the door."

Solution: A New Control System of Auto-locking Door (Part 2)

(6) The Door itself is operated slowly and safely, just as usual at present:
Opens slowly, closes slowly, being unlocked for about 10 seconds, and re-opens in case of any obstacle for the purpose of safety.

(7) An IT system is built for giving door control operations. The system must have image processing ability and work with the panels for authentication.

(8) The IT System monitors with a video camera around the door, and understands in real time the accumulated number (*e*) of persons who have entered the door (since the door is opened this time) and the number of persons who are going to enter the door.

(9) The IT System cooperates with the panel for authentication operation and understands in real time the accumulated number (*a*) of persons who are approved in the authentication (relevant to the door opening of this time).

(10) 'Number of persons left with authentication' (*p*) is defined by 'accumulated number of authenticated persons' (*a)* minus 'accumulated number of persons entered the door' (*e*). *p* is used for giving door-open/close orders and for controlling the notice/alarm displays.

Solution: A New Control System of Auto-locking Door (Part 3)

(11) While 'Number of persons left with authentication' $p > 0$, the System gives the Open-Door direction and displays 'Please enter' at the top of the Door.

(12) While $p = 0$, the System gives the Close-Door direction and displays as 'Please get authentication on the panel, right (for residents) or left (for visitors) for entering the door'.
This is a normal state. If the Door is open, it will start the closing motion. When the Door is closed and locked, the variables *a*, *e*, and *p* are reset to be 0.

(13) While $p = 0$ and the Door is not locked, if the System detects any person who is going to enter the Door, it makes the display (12) on and off, and make an announcement for notice.

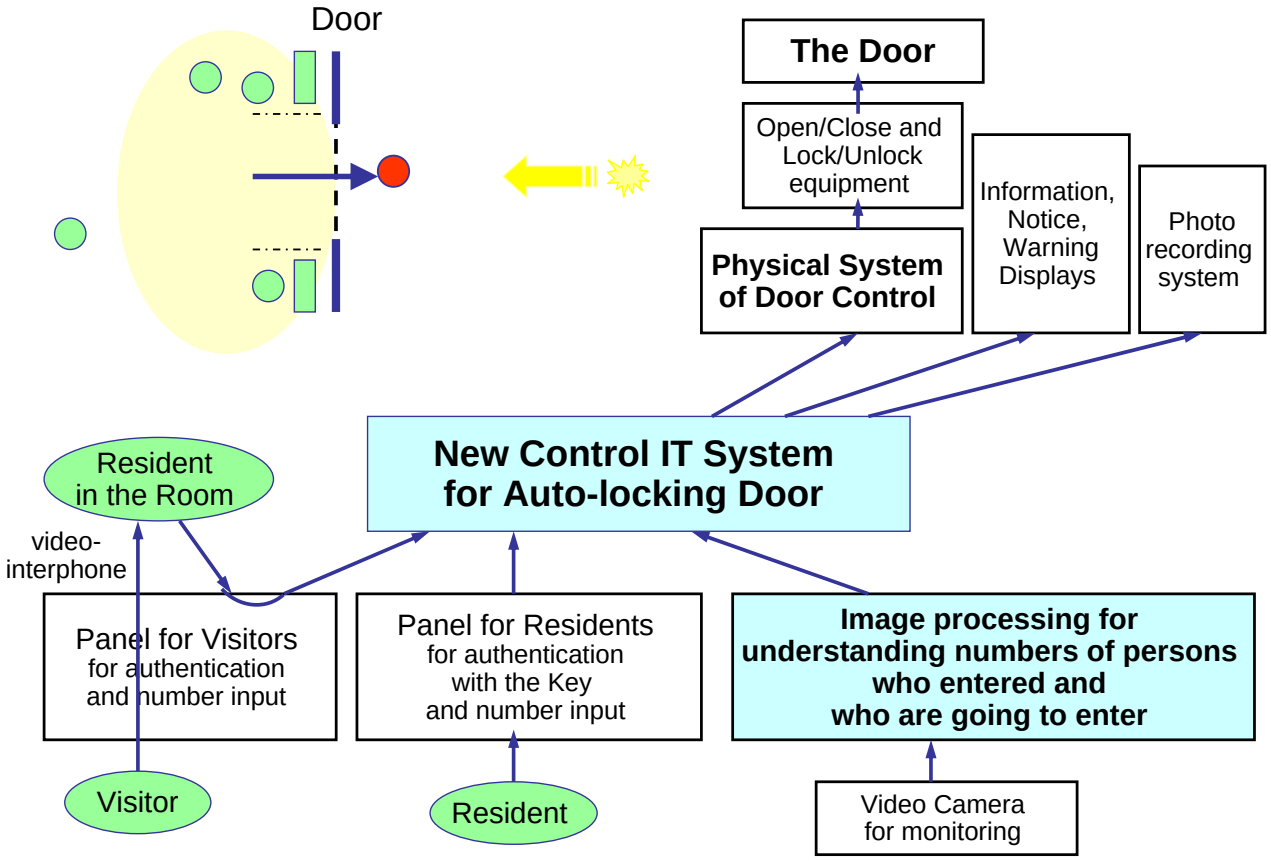
(14) When *p* turns to negative (and also increases in its absolute value with $p < 0$), the System has detected a violation of the rule.
Thus it turns the flash light on and takes a photo from front of the person who has just entered the Door. And it displays and announces as 'Since it is detected that more persons than those authenticated have entered the door, a photo is taken for the security reasons. To avoid this inconvenience, please enter the Door after getting authentications.'

Solution: A New Control System of Auto-locking Door (Part 4)

(15) While $p > 0$ and nobody has entered for the last preset period of time (say 10 sec), the System gives the Close-Door direction.
When the Door gets closed and locked, the variables *a*, e, and *p* are reset to 0.

(16) The records of operations, especially the photoes taken, are analyzed later, desirablly every day, by the manager for the purpose of making appropriate means both individually and generally for increasing the security of the building.

Solution: A New Control System of Auto-locking Door



Conclusion

TRIZ/USIT has been applied to the Security Problem of Auto-locking Door System.

Analysis: Human psychology and social understandings are important factors.
Viewed with many different perspectives. Used KJ Method as well.
Clarified the Cause-Effects relationships.

Solution Generation:

Considering psychology and social manner, a rule has been set up clearly.
A new technical system has been designed to enforce the rule.

An IT Control System was designed using real-time image processing.
On the basis of information, the Door Open/Close is logically controlled and notice and warning are displayed.
Physically, the big and heavy Door is slowly opened/closed and operated on the safety side to avoid any accidents.

TRIZ Principle 28: Substitution of Mechanical System
Mechanical & Physical Door ==> IT & Logical Door

An everyday-life problem was solved by use of TRIZ/USIT with the perspectives of Sociey, Human, and Technology.