PROCEEDING

JOINT RESEARCH SEMINAR

FACULTY ENGINEERING OF SHIZUOKA UNIVERSITY

WITH

INFORMATICS ENGINEERING OF PASUNDAN UNIVERSITY

4th Campus of Pasundan University

Jl. Dr. Setiabudhi No. 193 Bandung

FACULTY ENGINEERING OF SHIZUOKA UNIVERSITY
WITH
INFORMATICS ENGINEERING OF PASUNDAN UNIVERSITY

PREFACE

Praise be to Allah, who has given mercy so that the research seminar held jointly by the Informatics Engineering of Pasundan University with Engineering Faculty of Shizuoka University, particularly from the Wada Laboratory. This joint seminar aimed at sharing research results in order to mutually utilize the results of the each research lab for the development of each and also explore the possibility of research collaboration between the two sides

From the Shizuoka University, the seminar included Prof.. T Wada as a team leader along with five of his graduate students. While Unpas of Informatics, involving 3 person lead researcher and 5 members. Electrical Engineering Shizuoka University presented five papers whereas Informatics Unpas three papers presented and a final product that is prototype building control system.

Papers from the University of Shizuoka majority of stubs in the area of telecommunications, while the topic from Informatics Pasundan University is Information Society as a result of the development of information technology and telecommunications. The relevance of the paper assosiated with the prospect of future cooperation to include (1) the use of several innovations in the telecommunications field of Wada laboratory to solve problems of telecommunications in rural West Java, (2) knowledge sharing and the lab facility for the manufacture of ICs from the building control system that it's prototype have been developed to be used as mass products (3) sharing knowledge about waste management in Japan's mobile phone.

We say many thanks to :

1.   Prof. Dr. Eddy Yusuf who has facilitated for this seminar
2.   Dr. Lili Satari who have initiated and arrange Seminar.

3. Dr. Yudhi Garnidha who has supported the research team informatics engineering pasundan university and pleased welcome to the team from Shizuoka

4. Drs. Dadang Bainur, which have helped the event welcoming to the team from Japan

In this proceedings was published 8 papers presented and discussed at the seminar shared the results of research among Informatics Engineering Pasundan University (4 papers) with the Faculty of Engineering, University of Shizuoka, especially from the Wada Laboratory (4 papers).

I hope these proceedings provide benefits to both parties who have worked together and also to the readers.

Best Regard,

Ririn Dwi Agustin
Head of Informatics Engineering UNPAS

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Model Optimization for Winner Determination
in Combinatorial Auctions – Simultaneous Multi Object

(Frequency Auction Case Study)

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Abstract

Spectrum, with its characteristics, requires a specific auction scheme to avoid the problems that occur as *winners curse* and *free rider problem*, especially the *complexity computation* problem. One of the auction schemes is the combinatorial auction with multi-object objects. The problems that arise in this auction scheme is an explosive combination of offerings that should be set as the winner. In this study, combinatorial problems are mapped as the Knapsack problem so can be solved with the idea of brute force approach or the heuristic approach with Genetic Algorithms. With brute force approach, the problem mapping is more simple but high computational complexity. While the idea of genetic algorithm approach, the problem representation becomes more complicated, but it ensures a lower computational complexity.

Keywords: spectrum, spectrum auction, combinatorial auction, knapsack problem, brute force, genetic algorithms.

A. Preliminary

1. Background

Radio Frequency Spectrum is a limited natural resource that has strategic value in telecommunications and dominated by the state. Radio Frequency Spectrum Utilization as a natural resource needs to be done in an orderly, efficient and in accordance with its designation so as not to cause harmful interference.

The need for speed development, flexibility and mobility, from time to time, has encouraged the increasing needs of radio frequency spectrum for wireless-based technology services. To meet the needs of data and Internet access service, since 2000 the Indonesian government has allocated radio frequency spectrum for BWA services consisting of BWA bands exclusive and non-exclusive.

There are a number of organizers who have obtained an exclusive allocation license of BWA frequencies previously granted based on the mechanism of "first come first served". This mechanism cannot be applied again when more demand for the allocation of frequency operating license. Therefore mechanism of "frequency spectrum auction" / spectrum auction becomes an alternative mechanism in frequency licenses request compliance.

2. Problem Identification

Specific characteristics of the frequency spectrum require a specific auction mechanism. Among other things, the frequency blocks on offer / bid to the extent possible contiguous placed side by side. This cause the block of frequencies being auctioned should be made packaging, so the auction is held to give per frequency package/package bidding. This is called a *combinatorial auction*, where every participant will win the bid as "all or nothing" to the auction object packages that they bid. Wide frequency spectrum should be split into blocks of homogeneous frequency which is then offered to

enthusiast frequency service providers. Blocks can be assigned a unique identity, so that each bidder can specify a block of interest.

To make an adequate competition, the auction should be held not once, but in some rounds. This gives opportunity for the bidders to bid several times. With so many frequencies objects / blocks are auctioned, bidding should be held simultaneously, to facilitate bidders in making bids. Thus, the auction must be held *simultaneous combinatorial auction.* In each round, the bidders allowed to bid / bidding more than once for packages of different offerings.

Other problems are of the operating license, due to the vast Indonesian state, then the permit may be granted on a regional per zone. Zones in Indonesia is broken down into several zones. Thus, the frequency of bid package consists of a block and a particular zone. At this time, the zone applied for 15 regions, but did not rule areas across Indonesia are grouped into 5 zones based on the islands. To improve efficiency, zoning can be implemented into only 3 zones, the form of West, Central, and Eastern.

As can be seen that there are requirements in the spectrum auction: packaging, repeated rounds of auctions, blocking, and zoning. These requirements will impact on the incidence of computing complexity problems, especially when determining the winner of the auction in each round. There are three variables that affect the complexity of each bid in each round, ie the number of bidders, the number of blocks, and the number of zones. Of the three parameters there will be combination offers explosion / bidding which influences the size of the search space in determining the optimum combination of offerings. As an illustration, four bidders; then there will be a $2^n - 1$ *combination;* so computational complexity is O^n *where n is the number of bidders.* If the license arrangements for the set per regional / zone off each other, then it would require more combinations to the area to be auctioned. If Indonesia is broken down into 15 zones, there are 15 x $2^n - 1$ *combination.*

3. **Purpose**

The purpose of this research is to create a model for the optimization of the determination of the winning bidder, for the most simple case until probably the most complex. A simple case if the number of bidders <5, a homogenous block / not unique, and zone = 3, while the most complex cases if the number of bidders> 20, a homogeneous blocks with identity / unique, and zone = 15.

A deterministic method used by the *brute force* method, and will be used for comparison with *genetic algorithm* heuristic methods.

B. **Methodology**

Here is a picture of the methodology used in this study :

Figure 1 Research methodology

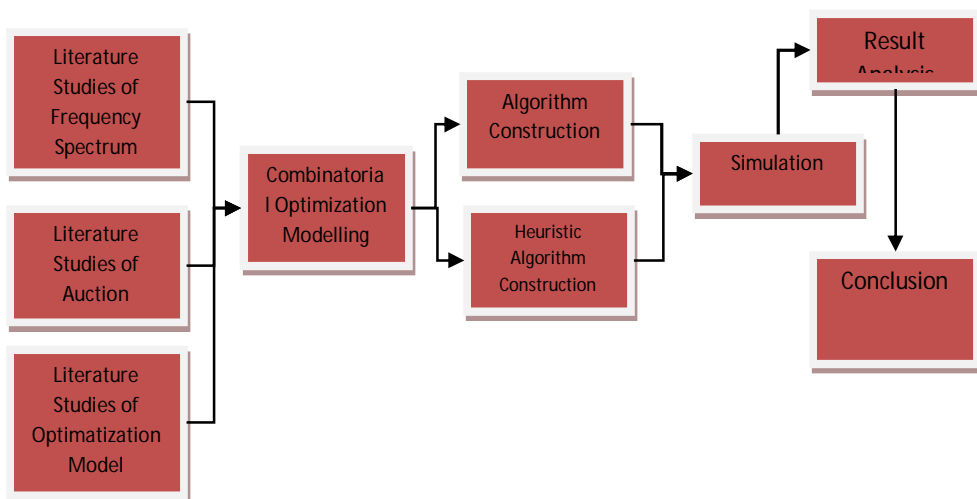The research begins by studying literature related to the frequency spectrum, auction, and the optimization model. Once it's done modeling of optimization problems contained in combinatorial auctions. Construction algorithm is then performed based on the combinatorial model, consisting of brute-force algorithms and heuristic algorithms. Both performed simulations to illustrate the problem of the same

auction. Further, do analysis of aspects of the simulation computation time and accuracy of optimization results and conclusions drawn.

C. Basic Theory

1. Frequency Spectrum

Radio Frequency Spectrum is a limited natural resource that has strategic value in telecommunications and dominated by the state. Radio Frequency Spectrum Utilization as a natural resource that needs to be done in an orderly, efficient and in accordance with its designation so as not to cause harmful interference.

Radio Frequency Spectrum is the structure of radio frequency bands that have a frequency less than 3000 GHz as a unit of electromagnetic waves propagating vibrations and are in aerospace (air space and outer space). Radio Frequency Allocation Spectrum of Indonesia determined by reference to the International Radio Frequency Spectrum allocation for region 3 (region 3) according to the Radio Regulations set by the International Telecommunications Union (ITU).

Indonesia national frequency allocation table based on the results of the Final Act World Radio Communication Conference-1997 held in Geneva, in November 1997.

To meet the needs of data and Internet access service, since 2000 the Indonesian government has allocated radio frequency spectrum for BWA services, as follows:

A. BWA EXCLUSIVE TAPES

    a. 300 MHz frequency band (287-294 MHz, 310-324 MHz)
    b. 1.5 GHz frequency band (1428-1452 MHz and 1498-1522 MHz)
    c. 1.9 GHz frequency band
    d. 2 GHz frequency band (2053-2083 MHz)
    e. 2.5 GHz frequency band (2500-2520 MHz and 2670-2690 MHz)
    f. 3.3 GHz frequency band (3300-3400 MHz)

g.   3.5 GHz frequency band (3400-3600 MHz), the secondary status of this band satellite service

h.   10.5 GHz frequency band (10150-10300 MHz and 10500-10650 MHz)

B. BWA NON EXCLUSIVE

a.   Ribbons 2.4 GHz

b.   Ribbons 5.2 GHz

c.   Ribbons 5.8 GHz

2. Auction

Auction / Auction is the process of selling and buying certain goods offered for auction and sell it to the auction winner. In economic theory, auction is a method for determining the value of a commodity that has the price could not be determined (variable price)

There are several characteristics of the auction, namely 1) Supply Auction where there are m sellers of goods, with one buyer (who bought the goods in accordance with the needs of the buyer). 2) Demand Auction, where there is one seller who offers to n buyers. Buyers with an appropriate supply of goods sold are entitled to it. 3) Double Auction where there are m sellers who offer goods to n buyers.

Auctions can be viewed based on its type, round which took place, the order of bidding, the object being auctioned, and based on the criteria of cessation of the auction. Can be summarized in the following illustration :
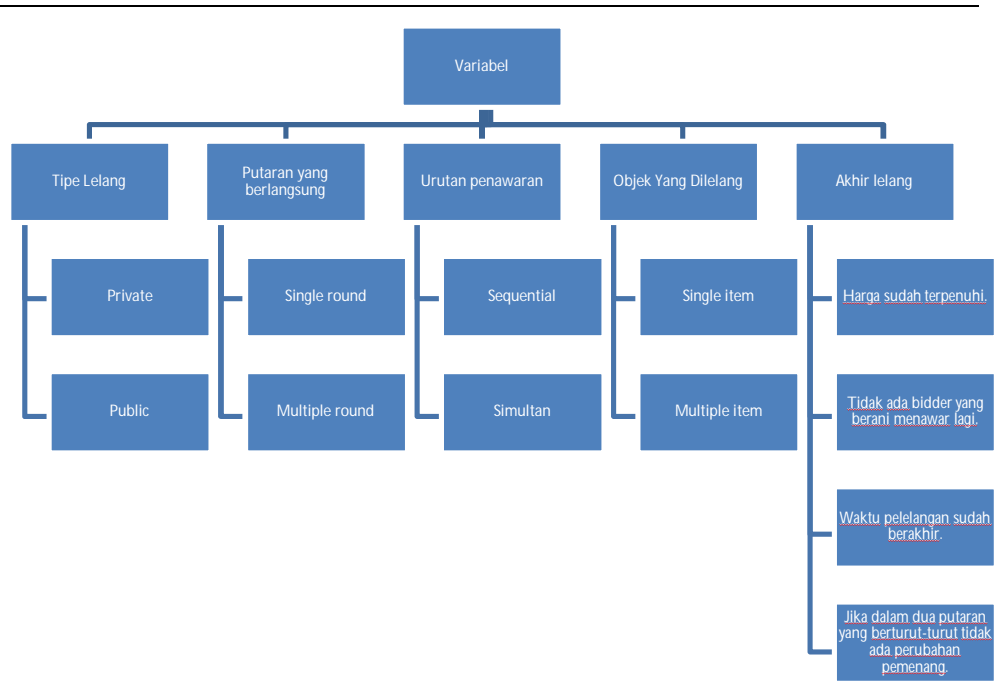
Figure 2 Categorization Auction

3. **Frequency Auction**

Frequency auction is basically an auction item with the object of the frequency spectrum. Characteristics of a typical spectrum requires a specific design. There are some specific auction designs destined for the auction of frequencies, among others: Auction Design in the FCC (Federal Communication Commission) and AUSM (Adaptive User Selection Mechanism), summarized in the following picture.

	FCC	AUSM
1.	iterative	continuous
2.	only 1 item bids	package bids allowed
3.	pay what you bid	pay what you bid
4.	maximize revenue to find winners	maximize revenue to find winners
5.	resubmit winners	resubmit winners
6.	minimum increments	submit any bid
7.	eligibility based stopping	auctioneer stopping
8.	all bids revealed	winners revealed public queue revealed

Figure 3 Summary of Frequency Spectrum Auction Design

The FCC auction design introduces Simultaneous Multiple Round (SMR) which implemented the principle of simultaneous and Multiple Round. There is a SMR development in the form of SMRPB by allowing package bidding. This study does not refer to specific designs ever developed, but focused on combinatorial problems that occur when determining the winner.

There are some specific issues related to auction spectrum as follows :

- Winner's curse, the winner paid too much for items that are offered,

- The exposure problem (the risks a bidder faces in trying to construct an efficiently large combination of licenses),

- The free-rider problem - the threshold problem (the difficulties small bidders have in beating those who bid for larger packages of licenses), and

- The computational complexity problem (which arises from the fact That the number of possible combinations of licenses is much larger than the number of licenses).

4. **Optimization Techniques**

Several case examples are included in the case of optimization problems including the *TSP (Traveling Salesman Problem), MST (Minimum Spanning Tree)*, and the *Knapsack Problem.* Some of the above cases are cases that require optimization techniques in the algorithm, the algorithm should be able to choose one of the best solution from a number of solutions to existing problems.

Optimization algorithms are divided into two types, namely the optimization algorithm with deterministic-based approach and optimization algorithms with probabilistic-based approach. Some that are included into the deterministic-based algorithms such as *State Space Search*, *Dynamic Programming*, and *Branch and Bound.* While the optimization algorithm is included into the algorithm based on probabilistic approach is the *Monte Carlo* algorithm with a variety of derivatives.

Evolutionary Computation is one of the algorithms that belong to the probabilistic-based optimization algorithm. Definition of Evolutionary Computation algorithms are abstractions of the theory of biological evolution is used to create a procedure or methodology of optimization, typically applied to computers, which are used to solve the problem. This algorithm has the basic idea of how evolutionary processes that occur in living things. Which assumes that evolution is the result of each will bring something better and optimal. *Evolutionary Algorithm (EAs)* is the algorithms that implement Evolutionary Computation abstraction. The algorithm is inspired from a mechanism in the biological sciences that is about mutation, crossover, natural selection, and survival. One that included into the EAS is **Genetic Algorithms (GA).**

5. **Genetic Algorithm**

In biology, living thing from the same species called *population.* They live, breed and die in an area. New individual is formed from the reproduction between two individuals or by mutation. Over time, genetic changes experienced by these species will provide a distinct advantage for the species. The principle was later adopted into a genetic algorithm.

In genetic algorithm, each problem solution will be incorporated into sets of chromosomes or individuals in it that are divided in several genes. Individuals are then combined into a single initial population. This population will experience a variety of processes on an ongoing basis to continually establish new populations through a series of iterations. In the last iteration, AG will provide the best single individual as the solution to the problem being solved.

Processes experienced by the population to re-establish a population consists of :

1. Two individuals selected as parents based on a specific mechanism. Both carriers are then carried out *a crossovers* giving rise to two new individuals / offspring.

2. By using a certain probability, the two *offspring* may be **mutated,** namely the changing content of the chromosome.

3. The new population is formed from a particular *replacement scheme.*

4. This iteration process will stop at a particular termination scheme *(stopping condition)* which may be a certain number of iterations, time, or the individual variance that larger than a certain value.

D. Model Optimization

1. Knapsack Problems

Knapsack Problem is a problem how to determine the selection of items from a collection of items where each item has a weight and profit, respectively, so that the selection of goods is obtained from the maximum profit.

Knapsack problem is one of the classic problems which are found in the literature old and until now the problem is still often found in everyday life. A concrete example of the *Knapsack Problem* is if there is a bag with a capacity of 15 kg, and there are 5 items with each of the weight and price as follows: {(12.4), (2.2), (1,2), (1, 1), (4.10)}. How to put these items into the bag, so that there is a maximum price that obtained with a maximum weight of the goods does not exceed the capacity of the bag.

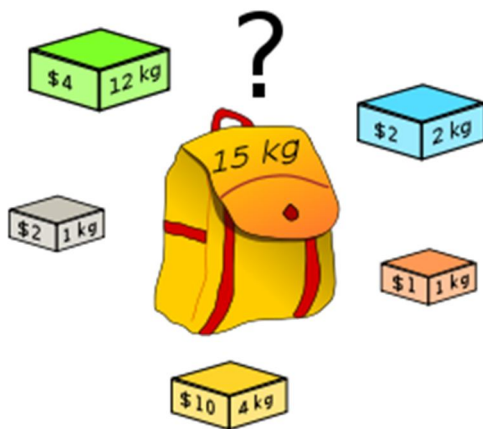| Item	Weight	Price
1	12	$ 4
2	2	$ 2
3	1	$ 2
4	1	$ 1
5	4	$ 10

Figure 4 Knapsack Issues Preview

Knapsack problem issues including category *1 / 0 Knapsack Problem,* where the selected item should be complete (1) or not selected at all (0).

Illustration issue knapsack 0 / 1 is as follows :

A Knapsack has a total capacity of *W*, where there are *n* different items that can be placed in the knapsack. Item *i*

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has a weight *and profit* . If *i* is the number of items to be included in the Knapsack that is worth 1 and 0, then the general goals to be achieved are :

$$\text{maximize } \sum_{i=1}^{n} b_i . x_i$$

$$\text{where } \sum_{i=1}^{n} w_i . x_i \leq W`$$

In the theory of algorithms, *knapsack* problem belongs to the group of **NP-complete.** Issues including the **NP-complete** cannot be solved in polynomial time order.

2. Mapping Issues Auction – Knapsack Problems

Determination of the winner in spectrum auction can be viewed as a Knapsack problem. As an illustration, there are examples involving the spectrum auction bidders, zone, and block as follows :

Area Code	Area Name
1	Sumatra
2	Java-Bali
3	Borneo
4	Sulawesi
5	Papua

Table 1 Illustration of Zone

Here is an illustration of the frequency spectrum to be auctioned :

Unit Number	Band Number	Lower (MHz)	Upper (MHz)	Lower (MHz)	Upper (MHz)	Bandwidth (MHz)
1	1	1755	1757.5	1850	1852.5	2.5
2	2	1757.5	1760	1852.5	1855	2.5
3	3	1760	1762.5	1855	1857.5	2.5
4	4	1762.5	1765	1857.5	1860	2.5
5	5	1765	1767.5	1860	1862.5	2.5
6	6	1767.5	1770	1862.5	1865	2.5
7	7	1770	1772.5	1865	1867.5	2.5

Unit Number	Band Number	Lower (MHz)	Upper (MHz)	Lower (MHz)	Upper (MHz)	Bandwidth (MHz)
8	8	1772.5	1775	1867.5	1870	2.5
9	9	1775	1777.5	1870	1872.5	2.5
10	10	1777.5	1780	1872.5	1875	2.5
11	11	1780	1782.5	1875	1877.5	2.5
12	12	1782.5	1785	1877.5	1880	2.5

Table 2 Illustration of Frequency Spectrum

While in the following table is an illustration related to bidding conducted by the bidders. Each participant is to bid only once for each round.

Bidders	Package	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Bid price
A	Package 1	2	0	1	6	6	41149.4291
B	Package 2	4	7	4	6	7	77543.354
C	Package 3	2	1	0	4	0	73903.1186
D	Package 4	6	7	6	7	0	108730.441
E	Package 5	3	1	7	6	8	29265.0465
F	Package 6	0	5	2	8	8	98722.3229
G	Package 7	6	0	3	2	3	87030.4253
H	Packet 8	0	5	8	8	4	61871.272
I	Package 9	3	5	7	0	4	85769.4127
J	Package 10	7	6	0	3	1	43288.6419
K	Package 11	3	5	0	2	1	30548.8499
L	Package 12	2	4	0	0	8	77738.1688
M	Package 13	3	8	3	0	1	21354.2871
N	Package 14	6	3	7	0	6	43907.7635
etc.							

Table 3 Illustration of Offer

Each block and the zone will have a value of *reserved price,* the initial price of the goods to be auctioned. Comparison reserved price is a value comparison between the reserved price of each district. Here is an example of its reserved price comparison :

Area	Reserved Price (In Million Rupiah)	Comparison
Area 1	16 000	8
Area 2	20 000	10
Area 3	14 000	7
Area 4	10 000	5
Area 5	8000	4

Table 4 Illustration of Reserved Price Comparison

Reserved price comparison value can be useful if in need of searching the value per block per zone of each bid package. Here is a formula price per block per zone based on value comparison reserved price mentioned above :

$$P_j = \frac{S - \sum_{i=0}^{j-1} C_i P_i}{C_j + \frac{1}{M_j} \sum_{i=j+1}^{n} (C_i M_i)}$$

Where :

P_j : Unit price in area j.

S : The total price offered in the package.

C_i : The number of frequency units in the *bid* package in the area i

M_i : The scale of the reservation prices at area i.

Calculations carried out in sequence from P_1, P_2, P_3 to P_n.

From the illustration above, the knapsack model is built are as follows :

- *Knapsack* weights are *W* is the maximum number of blocks are provided, in this case is 12 blocks for each zone. Because there are 15 zones, then the blocks are available is 60, but the checks carried out per zone with maximum blocks per zone is 12.

- *n* objects, each of which weights are $w_1, w_2, ..., w_n$ represents the per-package deals made by the bidder.

- *n* number of object value which each object value represented by $b_1, b_2, ..., b_n$ represents the per-package deals made by the bidder.

- Knapsack problem is to find the value of x_i such that the maximum $\sum_{i=1}^{n} b_i . x_i$ is reached with the restriction $\sum_{i=1}^{n} w_i . x_i \leq W$

3. Settlement Knapsack Problems with Brute Force

Following are the completion step of knapsack problem with brute force approach :

- Generate all combinations of all the bidders, so that there is $2^n - 1$ *or* $2^{14} - 1$.

- Check all the combinations, if it violates the constraint that the number of blocks of each zone must be less than or equal to 12 blocks, then removed from the combination.

- Sort all combinations that meet the requirements, select the combination with *high revenues* based on its *bid price.*

To avoid an explosion of combinations, it is done checking *constraints* at the time of generating combinations.

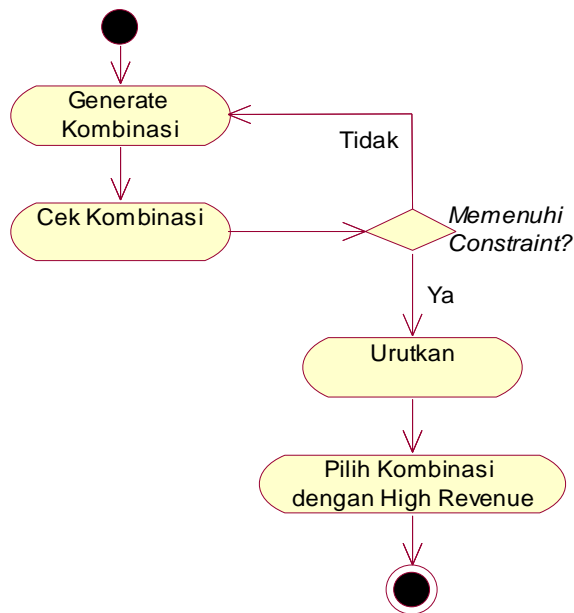Here is a diagram for solving knapsack problems with brute force approach :

Figure 5 Brute Force Approach

As an illustration, the following picture of combinations that can be generated and which meet the constraint or not :

Bidders	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Bid price	Constraint Zone
A	2	0	1	6	6	41149.4291	√ (fulfill)
AB	6	7	5	12	13	118692.783	x
AC	4	1	1	10	6	115052.548	√
AD	8	7	7	13	6	149879.87	x
AE	5	1	8	12	14	70414.4756	x
AF	2	5	3	14	14	139871.752	x
AG	8	0	4	8	9	128179.854	√
AH	2	5	9	14	10	103020.701	x
AI	5	5	8	6	10	126918.842	√
AJ	9	6	1	9	7	84438.071	√
AK	5	5	1	8	7	71698.279	√

Bidders	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Bid price	Constraint Zone
AL	4	4	1	6	14	118887.598	X
AM	5	8	4	6	7	62503.7162	√
AN	8	3	8	6	12	85057.1926	√
....	....	....	....	....	....	....	....
ABC	8	8	5	16	13	192595.902	x
ABCD	14	15	11	23	13	301326.343	x
ABCDE	17	16	18	29	21	330591.389	x
ABCDEF	17	21	20	37	29	429313.712	x
ABCDEFG	23	21	23	39	32	516344.137	x
ABCDEFGH	23	26	31	47	36	578215.409	x
ABCDEFGHI	26	31	38	47	40	663984.822	x
ABCDEFGHIJ	33	37	38	50	41	707273.464	x
ABCDEFGHIJK	36	42	38	52	42	737822.314	x
ABCDEFGHIJKL	38	46	38	52	50	815560.483	x
ABCDEFGHIJKLM	41	54	41	52	51	836914.77	x
ABCDEFGHIJKLMN	47	57	48	52	57	880822.533	x

Figure 6 Illustration of Brute Force

This research will be automated *brute-force approach,* with the input of the number of bidders, bidding of each bidder, constraint zone. The output is a combination of the best deals / high revenue. Computing will be evaluated based on the performance of the computational aspects of speed and accuracy.

4. Completion of Knapsack Problems with Genetic Algorithms

In solving the Knapsack problem with Genetic Algorithm, which first made is a representation. Next, set of constraints and then set the parameters in genetic algorithms. Here is a step details of the application.

1. Bidding Representation

In this representation, it takes two arrays, where the first array contains the **weight** represents the number of blocks bid by each zone, and the second array contains the bid price.

Weight / Block:

Zones \ Bidders	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	2	4	2	6	3	0	6	0	3	7	3	2	3	6
2	0	7	1	7	1	5	0	5	5	6	5	4	8	3
3	1	4	0	6	7	2	3	8	7	0	0	0	3	7
4	6	6	4	7	6	8	2	8	0	3	2	0	0	0
5	6	7	0	0	8	8	3	4	4	1	1	8	1	6

Bid price:

A	B	C	D	E	F	G
1149.43	7543.35	73903.12	108730.4	29265.05	8722.32	87030.43

H	I	J	K	L	M	N
61871.27	85769.41	43288.64	30548.85	77738.17	21354.29	43907.76

2. Chromosome Encoding

From the above representation, the representation of chromosomes obtained as follows :

N	M	L	K	J	I	H	G	F	E	D	C	B	A
0	0	0	0	0	0	0	0	0	0	0	0	0	1

That is, a combination package of a selected bidder with a total revenue based on the bid price: 41149.43

N	M	L	K	J	I	H	G	F	E	D	C	B	A

0	0	0	0	0	0	0	0	0	0	0	0	1	1

That is, a combination package of bidders A and B was chosen with total revenue based on the bid price: 118692.7831.

Further, chromosome 1 is represented in the array dimension that contains 1 or 0.

1	0	0	0	0	0	0	0	0	0	0	0	1	1

Which means that the package of bidders A, B, and N-elect. Revenue derived from the calculation of bid price.

3. Constraint

Since the package consists of zones and blocks, then it should be evaluated for a combination of each packet so as not to violate the constraint (the number of blocks per zone of $\leq$ 12). There are several variants of the problem which determines the constraint:

1. Bidders can only win the bid package is all or nothing for all zones and blocks.

2. Bidders can win the bid package as part of the block to the entire zone.

3. Bidders can win the bid package in some zones for the entire block.

In this study focuses on the principle of all or nothing, so the constraint applied is that all offerings / bid must not exceed 12 blocks for each zone. If any constraint is violated, it is not selected.

4. Termination Conditions

Search for solutions stopped if there are> 60% of chromosomes that have a maximum fitness value **or a** larger amount of evolution predetermined limit (if the amount of evolution> 1000).

5. Fitness Function

On evolution in the real world, individuals of high fitness value will survive. While the low fitness worth individuals will die. In the AG, an individual is evaluated based on a certain function as a measure of its fitness value.

Fitness value is obtained by adding the bid price of each bid that was elected into the knapsack. If the total weight in one chromosome is greater than the maximum capacity of knapsack, then the fitness value assigned 0.

In addition of calculating fitness values, also calculated the total weight of each chromosome then checked, which if there is a severe chromosome total exceeds the capacity of the knapsack, it will do the search for genes in the chromosome which has a value of 1 to be replaced with a value of 0. This is done continuously to ensure that all chromosomes that violate no constraint.

To prevent the presence of dominant individuals within a population (in the choice of parent for crossover), we need a Linear Fitness Ranking function. This function will reduce the value of fitness differences between individuals, so the difference between the best fitness values with the lowest fitness values can be minimized. With it so each chromosome has a chance of being selected into the parent more evenly (more fair).

6. Selection Function

In this research used Roulette Wheel selection method combined with Elitism. Roulette Wheel is chromosomes selection method to be used as parent, which chromosome with high fitness has a greater chance to be a parent. While Elitism is a

method that is useful to maintain the best value of fitness of a generation so it does not inherited to the next generation.

In the AG, the way is to copy the best individual (maxfitness) as much as needed.

7. Crossover

Crossover is the process of combining the bits in a chromosome with another chromosome that was selected as a parent. The number of chromosomes that have crossover is determined by the parameters Pcrossover. Where this Pcrossover are assigned by 80%, as expected 80% of the population suffers from the crossover to a population of individuals become more varied.

8. Mutation

Mutation is required to restore the information bits that are lost due to crossover. Mutation is done at the gene level, and the number of mutated genes that we limit in Pmutasi variable of 5%. This value is taken as more genes are mutated, the quality of an individual may experience a decline.

After mutation, each chromosome is checked again whether or not violated the constraint. If there is a chromosome whose total weight exceeds the capacity of the Knapsack, then randomly, a gene that is worth 1 will be replaced with 0 to chromosome does not violate any constraint.

Here is an overview of the steps on the approach with Genetic algorithms:
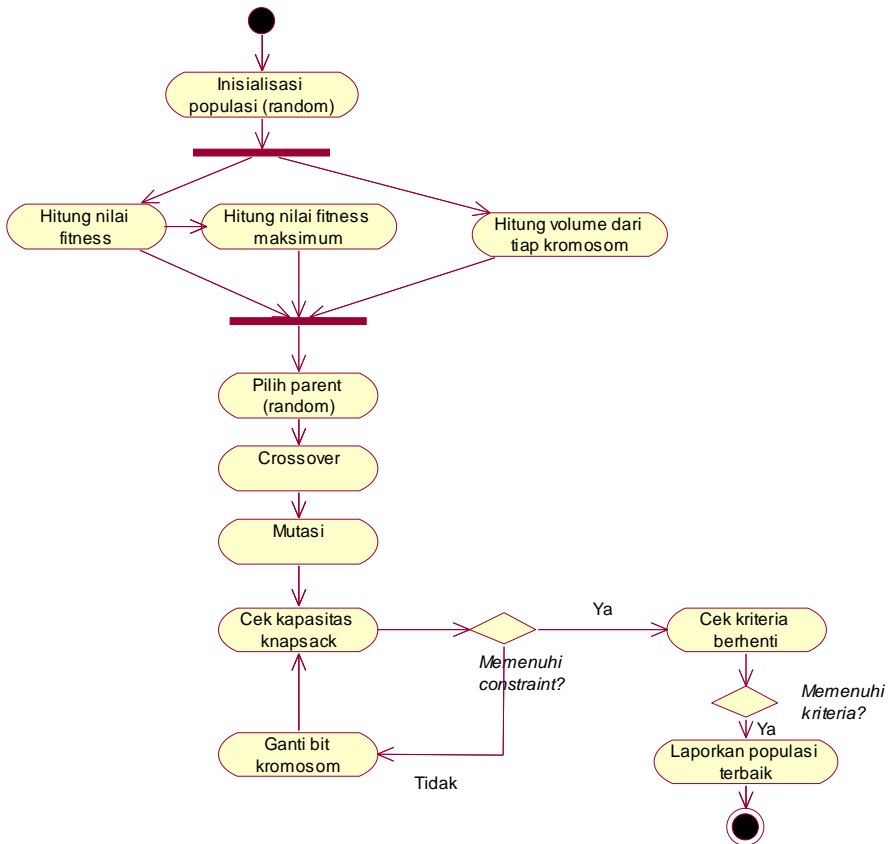
Figure 7 Approach with Genetic Algorithm

E. Conclusion

Here is the tentative conclusion of this study:

- Frequency auction problem can be stated as a problem of knapsack
- Knapsack problem can be solved by brute-force approach or a heuristic method with genetic algorithm.
- With brute force, representation of the complexity of the problem becomes simple but more complex in the search space of 0^n *where n is the number of bidders involved in the auction.*
- With a genetic algorithm approach, problem representation becomes more complicated, but the search space can be reduced so that computing time will be shorter.

F. *Future Work*

There will be Implementation of the settlement of optimization auction problems with genetic algorithm and compared with the brute force approach. Implementation will be done in programming language Java and Netbeans. Parameters for comparison are computing time and accuracy of the results of execution in the same hardware environment.

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Utilization Strategic of Information and Communication Technology for Rural Community Empowerment in West Java

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Abstract

Utilization of Information and Communication Technology (ICT) for business interests in urban areas has become imperative in order to compete with competitors. Due to the considerable gap in the provision and use of ICT between urban and rural areas lead the digital divide. Utilization of ICT in urban areas may not be entirely suitable for rural areas because of a number of factors that influence it. So many rural villages with a variety of classifications that exist in Indonesia generally and in West Java in particular, each community has a level of maturity in accepting different ICT anyway. In order to utilization of ICT in rural areas it can run effectively, it is necessary to measure the maturity level of each village. So that could be made an ICT implementation strategy in accordance with the maturity level of each village.

Keyword: ICT, Measurement Maturity, Strategy, Rural Community Empowerment.

1. Preliminary

1.1. Background

1. Potential village,
2. Development of communications and information technology,
3. Utilization of mobile phones (mobile / mobile) are increasingly widespread, from the number of users and uses, not just for communication
4. Mobile phone and pulse rates are more affordable

1.2. Problem Identification

1. Low mobilization (note: due to large areas, the population are rarely / scattered)
2. Inadequate transport infrastructure
3. low economic value of rural outcomes because of limited transportation and information

1.3. Objective

Purpose:

1. Measuring the level of maturity villagers in West Java in readiness to receive and use ICT.
2. Utilization of information technology to formulate strategies for empowering rural communities with access to media mobile phone (note: includes government policy, governance, infrastructure, content, implementation strategies).
3. Developing a prototype information technology for rural communities in accordance with the potential dominant villages concerned.

Benefits:

1. Empowering communities in rural communities to enhance the economic value of rural outcomes with improved means of communication and access information quickly and cheaply

1.4. Scope

1. Village that became the subject of research is the villages that the area has already covered by cellular service.
2. Parties are empowered in the village is a community of indigenous and rural economic powerhouse.
3. The village is used as model is coastal villages, agriculture and industries that exist in each of the villages.
4. The prototype includes content, software applications, governance, and strategy implementation.

2. Methodology

1. Defining the village, cellular technology, community empowerment, IT intervention strategies.
2. Formulate measure for classifying villages according to the readiness to accept information technology (e-readiness) (Phase II). (Note: there are six factors according to the EIU (economist intelligent unit) & IBM as connectivity, business environment, social and cultural environment, legal environment, government policy and vision, consumer and business adoption).
3. Formulate intervention strategies for the empowerment of rural communities IT.

3. Reference

3.1. Understanding of the Village

1. Backward Village or 'Swadaya' Village

   Backward Village is the village that lacked of human resources or labor as well as a lack of funds and is unable to exploit the potential that exists in the village. Backward villages usually located in remote areas far from the city, and the poor living standard of traditional and do not have the facilities and infrastructure supporting an adequate.

2. Developing village or 'Swakarsa' village

   Developing village is the villages are starting to use and exploit the potential of physical and nonphysical owned but still lacks the financial resources or funds. This village has not been a lot of rural infrastructure which is usually located in remote rural areas of transition and urban area. In this villages education levels are still low.

3. Developed Village or 'Swasembada' Village

   'Swasembada' village is the villages that were well advanced in terms of human resources and also in terms of capital funds. so it's been able to harness and use all the potential physical and nonphysical village maximally. 'Swasembada' village life was like a modern city with the work of diverse livelihoods and facilities that are complete enough to support rural community life forward.

3.2. Government policy in overcoming poverty

The Government of the Republic of Indonesia has set a long-term plan (year 2004-2015) to alleviating poverty, which will be presented in Working Paper SPKN. In accordance with government policy, Poverty Reduction Committee has formulated two main approaches towards poverty reduction, namely:

a. Adding the income of the

poor by increasing productivity and managerial ability and help them gain opportunities and better social protection in order to achieve social status, economic, and better political

b. Reduce financing basic such as education, health, and infrastructure-in order to support social activities and economic development.

3.3. ICT in Development in Indonesia

In Indonesia, exploiting the potential of ICT to assist government efforts to reduce poverty is still very rare. Now is the perfect time to revive the fight against poverty in Indonesia with the empowering role of ICTs in national development, coupled with other measures taken to reduce poverty.

ICT strategy is urgently bringing together the three main developments in Indonesia which will be united together into a powerful force for improving the lives of the poor in Indonesia. First, the ICT strategy will strengthen the national commitment to embrace and exploit ICTs under the auspices of the National Framework for Information Technology (National Information Technology Framework). Second, the ICT strategy will enhance national efforts to reduce poverty as stated in SPKN. Third, implementation strategies that take advantage of a decentralized approach will encourage the transfer of roles and responsibilities of central government to the local level.

3.4. ICTs to help alleviate poverty

ICT helps effectively proved successful efforts to reduce poverty in the developing countries, such as Peru, China, Solomon Islands, Zimbabwe, and India.

The experiences and lessons learned from similar efforts elsewhere shows that ICT is most effective when used as a tool for development, support development strategies that have been implemented or will be prepared, than if ICTs are expected as a fruit or a result of development itself. Therefore, the ICT strategy offers additional moves to complement the technology is applied, in order to better ensure its effectiveness in fighting poverty.

ICT optimum results would be obtained if the technology is embedded in a development strategy that spans the 'hierarchy is telling. Otherwise, ICT will only be a problem-solving, and their impact is less certain. The relationship between ICT and Development can be seen in Figure 1.

To encourage the development of ICT strategy in Indonesia, then a number of related observations and lessons can be drawn from the experiences elsewhere are applying the potential of ICTs should be considered:

1. By themselves, ICTs can play a role not optimal
    If there is no surefire strategy development, then ICT cannot be expected to provide optimum results. Both the causes of poverty, as well as the needs of the poor and the marginalized should be targeted precisely, especially pertaining to women and children. Each discourse that use ICTs in an effort to reduce poverty requires that the proponent defines the supporting elements that are essential to achieve the desired results.
2. ICT is best harnessed to improve the processes that have been going pretty well

ICT development cannot fix a failing, but ICT can make a successful development for the better. Technology is just one component in development. There are a number of other components that must function effectively so that technology can make a contribution. Component which has been running well in development, will contribute even more effective when using ICT. If used incorrectly, ICT will only add to the burden of unnecessary costs and will lead to frustration among users and advocates if the expected results did not appear, thus inhibiting further attempts to utilize ICTs.

Strategi Pembangunan

- Kebijakan pembangunan
- Sasaran dan tujuan
- Orientasi perubahan
- Penetapan prioritas

Potensi dan dampak informasi dan teknologi

Ke mana arah pembangunan dan mengapa?

Menunjang pembangunan

Arah pembangunan

Strategi Informasi

- Berbasis pembangunan
- Berorientasi pada kebutuhan
- Berfokus pada penerapan

Informasi apa yang diperlukan?

Infrastruktur & layanan

Kebutuhan & prioritas

Strategi Teknologi

- Berbasis aktivitas
- Berorientasi pada suplai
- Berfokus pada teknologi

Bagaimana cara pengadaannya?

Sumber dan kemampuan

Biaya dan kapasitas

Strategi Keberlanjutan

- Dimensi finansial
- Dimensi informasi
- Dimensi manusia

Bagaimana layanan dapat dipertahankan?

3. ICT users are usually the ones who are already familiar with ICT

At the time of ICTs are introduced then the person will soon be able to use it. The first group to embrace the technology is usually the ones who educated, capable, and who realize its usefulness. That fact may have a positive impact, but the risk of setting aside the uneducated, who could not afford, and who are not aware of its usefulness. Therefore, intevetion of ICT must be conformity with care Of poverty

mechanism, targeting especially those who are less fortunate, to share with them the advantages that ICT can be given.

4. Effective application of ICT involves both technology infrastructure and information infrastructure

   Mobilize the sources of information into an integrated infrastructure and methods require very different skills needed to build the technology infrastructure. ICTs can be an effective tool to fight poverty, but the spread of technology should not be a final destination. Radical changes in organizational roles and responsibilities will occur; for it need to be enforced mechanism that can change the management mechanism is less effective. These measures usually require direct intervention from the government.

5. In rural areas of developing countries (*which is predominantly residential*), installation and maintenance of technology infrastructure is relatively easy compared to the procurement of information infrastructure.

Infrastructure of Indonesian is poor and retarded. Creatively tackled urgently is needed, in order to realize the connectedness (connectivity) of rural communities. Many island communities are still not connected via cable telephone facilities, especially with the Internet. The solution of the problems can be a very technical challenge, so that technicians need to be deployed reliably available. However, no matter how creative and efficient technology, implementation will always be judged from the results of its application. Nevertheless, the technological challenges should not divert attention from the main purpose of building information infrastructure.

6. With ICT, we deserves hope; even the unexpected can emerge as a result

   Implementation of ICT brings its

own dynamics and projects must recognize that the application of technology will change the dynamics of the problem. For example, can be obtained results that was never expected, but it was better than expected. That happens when people apply the technology themselves according to their needs, which may not be planned by the proponent. Things like that just good, indicating the success of interventions in response to social needs.

7. ICT may open opportunities for development, but the expected result always comes from human activities

Information infrastructure, and especially the people in it, builds an environment that holds the key determinant of quality results. If the main focus on technology, there is a tendency to forget the human element. Education and skills are key to the effectiveness of the use of ICT opener, but so are the attitudes of the person. Therefore, the implementation of ICT requires an effective method to change them.

3.5. ICT in Development Effectiveness

There are certain activities — especially in effort to reduce poverty— that can be optimalized by ICT. Correlation these activities with the four pillars of poverty reduction made by the Government of the Republic of Indonesia can be seen in Table 1.

Table 1. Correlation ICT with Goverment Effort to Reduce Poverty

Field activities to be optimized with ICT	Four Pillars Of Poverty			
	Creating job opportunities	Empowering People	Increasing competence	Creating Social Protection

Field activities to be optimized with ICT	Four Pillars Of Poverty			
	Creating job opportunities	Empowering People	Increasing competence	Creating Social Protection
1. Empowering disadvantaged and marginalized people		√		
2. Stimulating mikro entrepreneurial	√		√	
3. Improving long-distance health information services (*telemedicine*)				√
4. Improving education through e-learning & lifelong learning	√		√	
5. Developing trade through e-commerce	√			
6. Creating a public administration more efficient and transparent through e-governance				√
7. Developing capability			√	
8. Enriching culture		√		√
9. supporting agriculture	√		√	
10. Creating job opportunities	√		√	
11. Encourage social mobility		√		√

3.6. Information Evolution Model

Information Evolution Model by Jim Davis and friends defines five evolution steps consist of how a company manage and use information. Model defines four dimensions for each step of Infrastructure, Knowledge Process, Human Capital, Culture that have a role to increase or decrease the value of a business information.

Tabel 1. **IE Model : Level dan Dimensi** Sumber J. Davis et.al-2006

Level	Infrastructure	Knowledge Process	Human Capital	Culture
Operate	Manual system or Non-network PC	Personal	Individual	No
Consolidate	Functional System	Departement	Functional Group	Our group vs 'the rest of the company'
Integrate	Enterprise System	Enterprise	Enterprise Group	All of us
Optimize	Extended Enterprise System	Extended Enterprise (Memperluas)	Extended Group	Our partner and us
Innovate	Adaptive System	Situational matrix	Dynamic Network	Adaptive Grouping

GROWTH OF HANDPHONE
WASTE and its treatment

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ABSTRACT

The rapid development of communication technology, causes the growth of handphone as one of its communication tools. Handphone is produced as a specific purpose gadget. So, in every new feature embedding that create a new product which replace the earlier one position. With the passage of time, these earlier products will grow as waste. There are three principal in waste processing, such as : Reduce, Reuse and Recycle.

Keywords: communication technology, mobile technology, microchip, operating system, demand, supply model waste management

1. PRELIMINARY

1.1. BACKGROUND

In this globalization era, the communication technology which grow rapidly is cellular phone (handphone). This product is the most popular one in the community that enable people to interact each other and communicate directly from anywhere and at anytime.

1.1.1. HANDPHONE EVOLUTION

This technology start to used since 1970 begin with microprocessor using for communication technology. In 1971, the first handphone network built in Finland called ARP. Followed by NMT in Scandinavia in 1981 and AMPS in 1983. The utilization of analog technology for first generation cause many debility such as small traffic and users capacity, and profuse of frequency spectrum. Beside that, the 1G technology can only serve voice communication, different with 2G technology that can serve text communication too, we knew it as short messege service - SMS. NMT (Nordic Mobile Telephone) is the first handphone network that used internationally in North Europe. This network operate at 450MHz, that is why it called NMT-450. There is also NMT-900 that operate at 900MHz frequency.

Associated with the market demand and the necessary of a better quality, born a second generation technology – 2G. This generation already use digital technology. These 2G technology are IS-95 CDMA, IS-136 TDMA and PDC. This second generation, beside serving the voice communication, it also used for SMS and data transfer with 9600bps maximum speed. Beside providing a better quality,

other benefit of 2G compared to 1G is larger capacity. Because on 2G, one frequency can be used for more than one user by using the Time Division Multiple Access (TDMA).

Because of the market demand that need more and more improvement to the communication services, came out the standard of 2G which become the most popular one, it's GSM (Global System fro Communication) that implemented in most of the cellular phone

The next generation of 3G, the latest technology in the cellular world. This generation is better known as UMTS (Universal Mobile Telecommunication System) or WCDMA (Wideband - Coded Division Multiple Access). The excess this latest generation lies in data transfer speeds up to 384 Kbps outdoors and 2 Mbps for indoor applications.

nowdays. It operates on 900, 1800 and 1900 MHz frequency and also support 14,4kbps of transfer speed for data communication. This 2G technology replace the 1G position.

After 2G, born the 2.5G and offcourse it was better then the earlier generation. Two things which were famous on this generation are GPRS (*General Packet Radio Service*) and EDGE (*Enhanced Data rates for GSM Evolution*).

In addition, the generation of 3G can provide multimedia services such as internet, video streaming, video telephony, and others better. This third-generation CDMA technology that originally came from the United States military technology and devoted to the IS-95 standard. Several patents on networks that exist today are based on CDMA technology owned by Qualcomm Inc.

1.1.2.   THE EVOLUTION OF MICROPOCESSOR

Rapid technological developments today, is the impact of the development of the microprocessor so that manufacturers can deliver the tools of advanced technology. ARM is a leading provider of 32-bit embedded microprocessors. By offering a range of processors based on common architecture that delivers high performance, with optimal efficiency of electric power.

On the Application Processor, mickropesesor have the ability to execute complex operations on complex systems, like Linux, Android / Chrome, Microsoft Windows (CE / Embedded), and Symbian, with the use of complex graphical interface system as well.
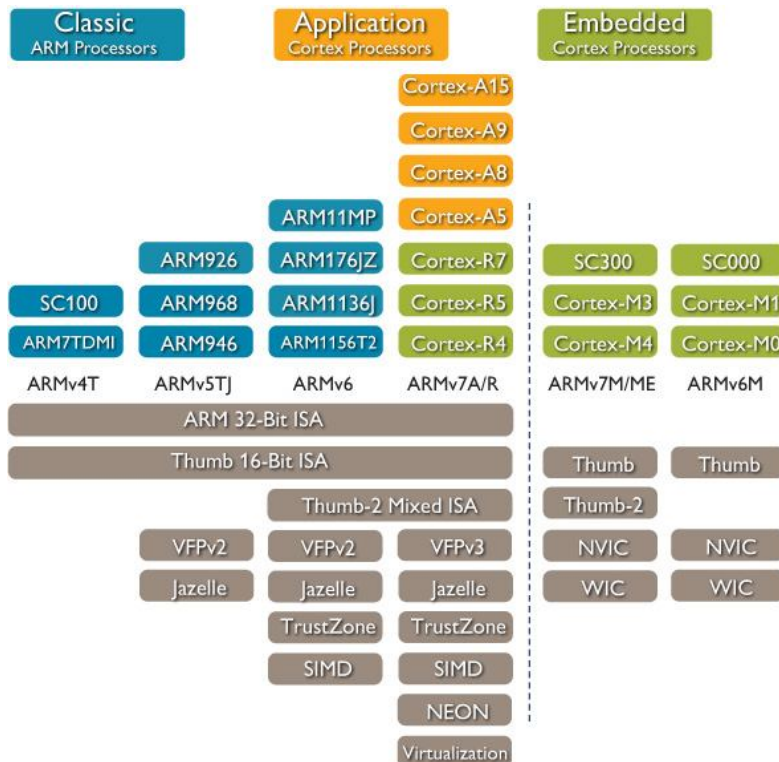
Figure 1. ARM Processor evolution

This class of microprocessor also integrates Memory Management Unit (MMU) to manage the memory requirements of a complex OS, and allows downloading and execution of third party software.

Applications for the class of processors include:

- Smartphone
- Feature Phone
- Smartbook * / Netbook / eReaders
- Advanced Personal Media Players
- Digital Television

A wide choice of processors available applications allow developers to choose solutions that match specific criteria of their application. Traditional single-core processors ranging from the basic level-ARM926EJ-S ™ through the Cortex-A9 ™ with the performance capability of up to 2GHz.

1.1.3.   ELCTRONIC WASTE

Consumerism attitudes in people's lifestyles that promote pleasure and comfort with leaving the old device altought in terms of usability it still able to function properly and optimally. In the process of development technologies generally new tools/devices will shift the old one. So by gradually increasing the time the old stuff is not used anymore and be what is called ELECTRONIC WASTE. Most of the waste are not degradable by nature and can disrupt human life in the future.

1.2. THEOLOGICAL PROBLEMS

Based on the background of the problems above, the formulation of the problem in this paper is as follows:

1. What problems are posed by the waste of electronic equipment, handphones?
2. How to deal with problems caused by waste electronic equipment, mobile phones?

1.3. PURPOSE OF THE PAPERS

Referring to the formulation of the problem above, then the purpose of making the author of this paper is as follows:

1. To find out what the problem posed by waste of mobile electronic devices.
2. To find out the way to solve the problem.

2. DISCUSSION

2.1. ELECTRONIC EQUIPMENT PROBLEMS

Cadmium is one of the chemical elements contained in the periodic table are known to have a symbol Cd and atomic number 48. Discovered by Stromeyer in 1817 from impurities in the zinc carbonate. Cadmium is always found in small amounts in zinc ores, such as sphalerite (ZnS). Greenokcite (CdS) is the only mineral that contains cadmium.

Almost all cadmium is taken as a result of production in the preparation of ores of zinc, copper and lead. This element is soft, metallic bluish white that can be easily cut with a knife. Cadmium has properties similar to properties of zinc metal.

Vapor of cadmium is very dangerous for humans because of very low melting point. Cadmium is a component of an alloy that has the lowest melting point. This element is

used in a mixture of metal shaft with a low coefficient of friction and durable. He is also widely used in the application of electric plating (electroplating). Cadmium is also used in the manufacture of solder, batteries, Ni-CDI. Sulfate salts are most commonly found and sulfide has a yellow pigment. Cadmium and solutions are highly toxic compounds.

Cadmium is very dangerous because it is one of the heavy metals and these elements are at high risk of dangerous blood vessel tissue. Cadmium effect on humans for a long time and can accumulate in body organs especially the liver and the kidneys. In principle, at low concentrations have an effect on lung disorders, emphysema and chronic renal disease turbular.

After one of the elements known to be a problem of electronic devices, the following will explain other elements that harm contained in electronic devices:

Plastic is one of the ingredients we can find in almost every item. Starting from drink bottles, TV, refrigerator, modified pipes, plastic laminating, dentures, compact disks (CDs), kutex (cleaning nails), automobiles, machinery, military equipment to pesticides. Therefore, we can almost certainly never use and have items that contain Bisphenol-A.

One of the items put on plastic and contain Bisphenol A is a food and beverage industry as a place to store food, plastic cover food, mineral water bottles, baby bottles and even now there are baby bottles and food storage that do not contain bisphenol A, making it safe for food use. One test proved 95% of people have been wearing items contain bisphenol-A.

Plastics are used because they are lightweight, do not break easily, and cheaply. However, the plastic also poses risks to the environment and health of our families. Therefore, we must understand plastics safe for our use.

1. PHTHALATES
Bahan Tambahan PVC

2. BFRs
Pelindung Circuit & Casing

3. LEAD
Untuk Circuit & Solder : Sangat beracun

4. CADIUM
Bahan Baterai : Pemicu Kanker

5. PVC
Isolator kabel

Ilustrasi Kandungan Racun Pada Ponsel
sumber : www.greenpeace.org
Kategori File : Toxics

Figure 2. Ilustration of harm component of a mobile phone

Most hand-phone users should have known about the radiation beam radio signals - the kind of "non-ionizing radiation" - the suspected cellular phone antenna can endanger the health of the user's brain hp, although so far the effect of the real danger is controversial and still in-depth research.

Yet another danger is more serious because the effect is a wider scope than just a danger to the mobile phone users just seem not to be thought most of the burden of hand-phone users, the dangers of environmental pollution caused by the accumulation of waste material from the hand-phone component and thrown away if it has been deprecated. Pile of toxic metallic components (figure 1 : - lead (lead), mercury, etc. - as well as plastics found in mobile phone waste is now staking a serious danger that could undermine the environmental sustainability of human life.

Cell phones are just one of many electronic devices today's household garbage heap can be a source of

environmental pollution. Waste electronic goods such as batteries, TV sets, video recorders, computers, or PDA-Personal Digital Assistant or "pocket computer" does contain components made of metal and plastic materials, which if dumped rubbish continually and carefully processed to a serious threat to the human environment.

Acceleration is fairly remarkable accumulation of electronic waste from the illustrated cellular phone users around the world in 1999 was about 480 million, and the numbers will swell. Assuming that the product life between 1-2 years, it is estimated there will be 500 million mobile phone devices that each year will be dumped into the trash. A unit hand-phone devices with components of the material of lead (lead), copper, and metallic mercury in units of counts may be relatively small, but taking into account the overall number of mobile phone devices in the form of millions of tons of landfill waste that would indeed be a serious threat to the preservation of the environment lives around the world.

Thus the problems arising from electronic tools are:

1. The amount of waste that is difficult to reduce
2. Cause harmful chemical elements

2.1.1.   PERTUMBUHAN HANDPHONE

2.1.1.1.   HANDPHONE SEBAGAI KEBUTUHAN PRIMER

Mobile (HP) is now just like a primary need. Many households now have cellphones, not only parents who have it but the kids until housemaid was also to have it. This is possible because the more inexpensive price of HP in the market and also the increasingly cheap mobile tariffs to the number of operators which mutually attract customers.
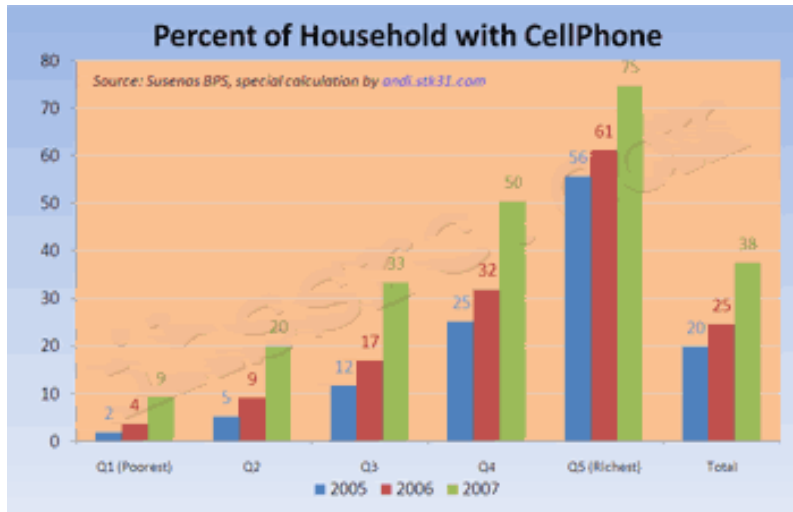
Figure 3. Percent of Household with cellphone

Figure 3. Percent of Household with cellphone in Indonesia From 3 years of the survey, it turns percent of households had mobile phones is rising sharply. What is interesting is the growth of households with HP among poor households (40% poorest households), the poorest group was nearly 500% growth since 2005, although the number of poor household users the new HP 9.4% in 2007. Likewise with the Q2 by 400% user growth. This suggests that poor households access to these modern devices have started a high since most likely because HP and Toll cheaper. In the future growth will probably continue to increase because now many of the active phone number for life.

Group of wealthy households are also not left behind, although not as fast as the growth of user groups of poor households but the increase is quite large especially when considering that this group of households that have the highest percentage of HP users. In 2007, approximately 74.7% richest households already have HP as a communication tool. Nationally, the growth of household users of HP rose nearly 200% from 19.9% (2005) to 37.6% (2007).
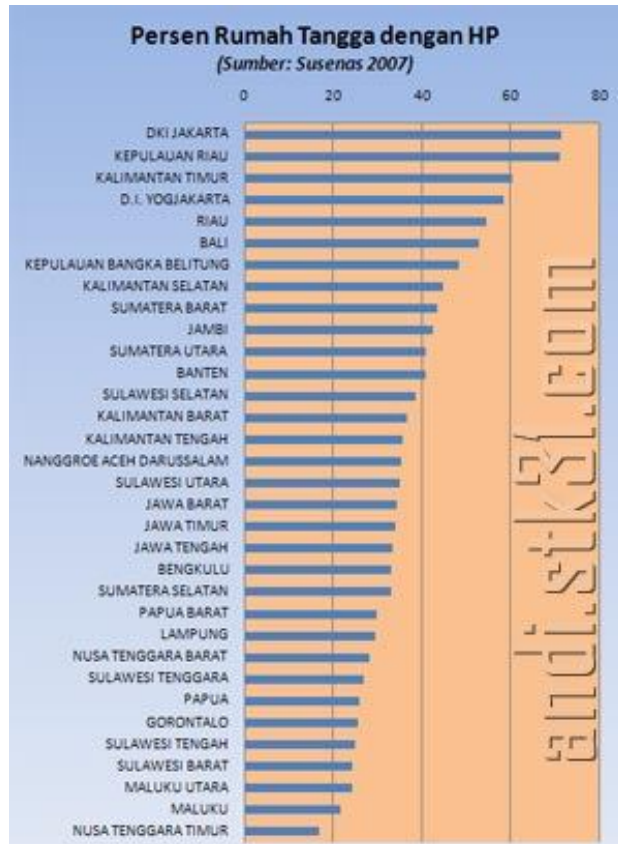
Figure 4. Percent of household with cellphone by provinces

2.1.1.2. INTERNET ACCELERATE THE CELLPHONE GROWTH

Growth in the number of users of mobile devices, such as mobile phones, tablets and netbooks outside estimates. That's what made Chief Executive Officer (CEO) of Google, Eric Schmidt in a speech at the event the Internet Advertising Bureau's Annual Leadership in California, United States.

"Users of mobile devices are growing faster than our forecast," Schmidt said as quoted by the tech site Mashable.

The conclusion that he got after observing the number of visitors to the YouTube site that plays more than 200

46

million videos per day for mobile device users. He also cites the results of calculations for multiple searches, such as GoDaddy is done 315 times through mobile devices. This amount is much larger than a desktop search through only 38 times (almost 10 time).

He added that as many as 78% of smartphone owners use their phones to shop. "This is the future and everyone will adjust," said Schmidt.

The following statistics Internet growth in Indonesia in 2007

Tahun	Pelanggan	Pemakai
1998	134.000	512.000
1999	256.000	1.000.000
2000	400.000	1.900.000
2001	581.000	4.200.000
2002	667.002	4.500.000
2003	865.706	8.080.534
2004	1.087.428	11.226.143
2005	1.500.000	16.000.000
2006	1.700.000	20.000.000
2007*	2.000.000	25.000.000

Tabel : Perkembangan Jumlah Pelanggan & Pemakai Internet (kumalatif)
* perkiraan s/d akhir 2007

Tahun	Domain Baru	Total Domain
1998	1.479	1.479
1999	2.126	3.605
2000	4.109	7.714
2001	3.433	11.147
2002	3.146	14.293
2003	3.628	17.921
2004	3.841	21.762

Tabel : Jumlah Domain Baru (Sumber: www.idnic.net.id)
* s/d Akhir 2004

Tahun	Akumulatif IPv4 (Dalam Blok)	Akumulatif IPv6 (Dalam Blok)
1999	256	-
2000	1.072	-
2001	1.553	-
2002	2.455	-
2003	2.505	131.073
2004	2.635	131.073
2005	2.505	131.073
2007*	5.170	655.361

Tabel : Penambahan IP Address dan AS Number
* s/d/ November 2007
sumber: http://www.idnic.net

	Feb 99	Jan 00	Mei 01	Mar 02	Mar 03	Des 03	Jan 05
Peak	2.05 Mbps	3.07 Mbps	40.96 Mbps	245.760 Mbps	620.595 Mbps	1.2 Gbps	3.9 Gbps

Tabel : Peak Traffic IIX

2.2. HANDLING OF ELECTRONIC PROBLEMS

Use of electronic equipment waste that cause problems are very harmful to humans and the environment. This required the handling of problems that are not sustainable.

One effort to make the electronics industry in Germany can produce more environmentally friendly product

that has been done IZM Fraunhofer Institute in Berlin, such as by continuing to work together to formulate the R & D industry TPI-Toxic Potential Indicator besides doing research to develop techniques and methods are aligned with the demands of environmental sustainability. TPI Index contains data such as high-potential poisoning hazard of the material content of the metal components of a cell phone.

Fraunhofer Institute IZM Research findings also produce solder from the amalgam material mixture consisting of tin-silver-coper as an alternative to the base material of lead solder with a high-power highly polluted environment. By applying a similar rule was the product lead-free cellular phone or "lead-free cellphones" made in Germany can be realized immediately.

For the Indonesian mobile phone users which is quite high growth markets in the Asia Pacific region, then sooner or later it will face the threat of landfill waste electronic products that can burden the environment.

The rapid increase in the use of cell phones drive also must remember certain characteristics of some of today's phone users in Asia - including Indonesia - which considers devices like hand-phone like "fashion" is often enough to feel the need to change the model in a relatively short period of time.

Presumably in welcoming the enforcement of obligations in the production process of recycling mobile phones, the Motorola producer who claims to have prepared with the future mobile phone products to 85% component of recycled material that is ready to be viewed as one of the leading mobile phone products to produce a friendly environment or "greenphone".

Unfortunately only U.S. made products are quite popular and widespread users when first cellular phone service, especially for the first model built in car phone - was introduced in Indonesia about 10 years yl, increasingly has become

increasingly submerged in the market and according to a recent survey, leaving only 1.52% of the users hp.

There is a service whose name Mobile Muster conducting waste disposal services in both mobile phones and structured, so it may be able to reduce though not 100 percent disposal of waste but at least the damaging factor is minimized.

Mobile-phone is deconstructed. The parts that can not be used again be disposed of in a designated protected from free land. Meanwhile, the parts can be reused (reuse) will be parsed and categorized for later reuse in new products.

3. CONCLUSION

From the explanations that have been described in the chapter sebelunya on electronic waste (mobile phones) which become problems in mitigation, it can be summed up as follows:

1. Problems arising from the use of electronic tools such as, mobile phones are:
    a. Generation of waste that is difficult to be reduced
    b. Produce the chemical elements that endanger such as cadmium, the amount of waste is difficult to reduce it, ozone depletion, Global Warming

2. Use of electronic equipment that cause waste problems are very harmful to humans and the environment. This required the handling of problems that are not sustainable, namely:
    a. Produce electronic device that are more environmental friendly as had been done IZM Fraunhofer Institute in Berlin
    b. There should be services that make e-waste disposal services are good and structured, so it may be reduced although not 100 percent disposal of waste but at least the damaging factor is minimized.
    c. There was an attempt on the electronic equipment should be dissected for any reusable parts.

Ishikawa Diagram of this paper discussion

Building Automation System

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ABSTRACT

Dealing with environmental issues (Go Green)such as reducing energy use in recent years, one solution is the application of the concept of Building Automation System (BAS), where the use of power tools in the building can be scheduled and monitored so that the efficiency of consumption electrical energy can be achieved.

The development of information technology has been covering many areas of life. These developments not only in terms of software, but also a combination of software and hardware. Unification of software and hardware can be implemented into the building control system, which is to automate and manage electrical devices and security through control center. Interfacing is done in communicating between system software and hardware in this case represented microcontroller.

Building Automation System (BAS) can be realized in this way. Coupled with web based interface and short messege service for remote controling can make it more convenient for the users.

Key words: Software, Interfacing, Building Automation System (BAS), Microcontroller, web, SMS

1. Pendahuluan

1.1. Latar Belakang

Kompleksitas rutinitas yang harus dihadapi manusia setiap hari semakin meningkat. Baik bagi sebuah individu ataupun organisasi. Seperti halnya manajemen gedung-gedung bertingkat yang banyak terdapat di kota besar. Gedung-gedung tersebut tentunya membutuhkan sumber daya yang besar, baik energi maupun manusia untuk dapat berfungsi. Sumber daya energi tentunya untuk mengoperasikan perangkat-perangkat listriknya termasuk keamanan. Kemudian sumber daya manusia untuk mengelola sumber daya yang lainnya dan juga termasuk faktor keamanan.

Penghematan sumber daya untuk rutinitas tersebut perlu dilakukan mengingat pentingnya efisiensi dilakukan dalam masa krisis energi seperti ini. Terutama di kota-kota besar yang menjadi sentra perekonomian dan pemerintahan. Sebagai contohnya pada tahun 2007 konsumsi listrik untuk wilayah DKI Jakarta dan Tanggerang sebesar 27.939 GWh atau sebesar 23% dari total konsumsi listrik nasional. Dan 29% diantaranya adalah pengguna dari sektor bisnis yang berada di Jakarta.

1.2. Tujuan Penelitian

1. Memperlihatkan pengembangan perangkat lunak yang melibatkan perangkat keras.
2. Memanfaatkan *microcontroller* untuk penjadawalan perangkat listrik.
3. Membantu aktivitas manusia dalam hal manajemen perangkat listrik dan keamanan di gedung.

1.3. Review Teknologi Terdahulu

Konsep building atomation system yang kompleks ditunjukkan oleh gambar 1 berikut.
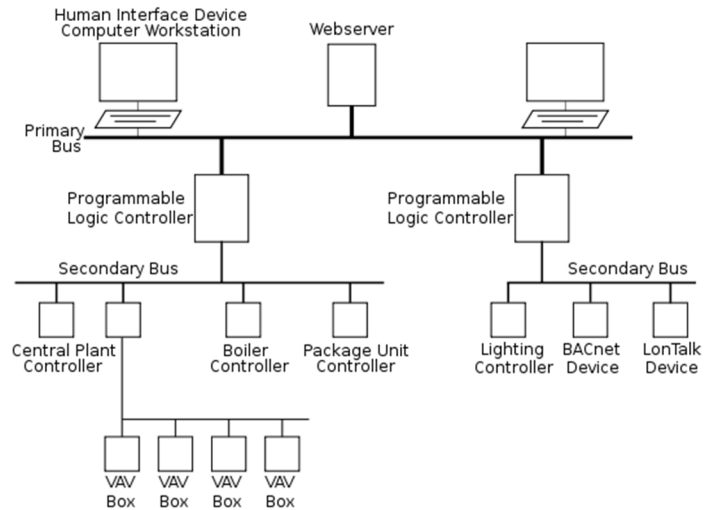
Gambar 1. Diagram Building Automation System (*sumber : Wikipedia.com*)

Pada penelitian ini dibuat sebuah maket untuk study kasus pengendalian perangkat listrik pada gedung dua lantai. Perangkat listrik lampu di tiap ruang menjadi satu titik kendali sistem(gambar 2 dan 3)

Gambar 2. Maket untuk simulasi
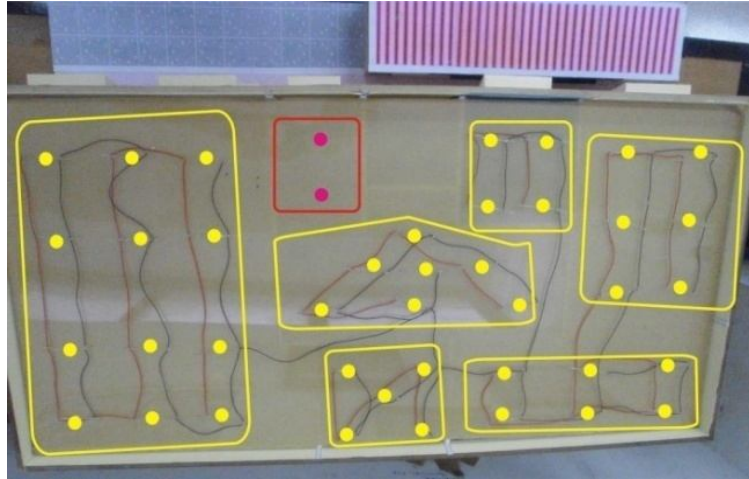
Gambar 3. Setiap ruangan menjadi satu titik kendali

2. Metodologi Penelitian

Dalam penelitian ini digunakan metodologi berikut :

- Study literatur
- Eksplorasi
- o Komunikasi serial pada software pengembang (Delphi 7).

- o Merancang *circuit board microcontroller* untuk memudahkan *interfacing.*
- o Merancang basis data perangkat listrik yang akan dikendalikan.
- o Merancang algoritma pengecekan jadwal valid saat ini.

3. Kebutuhan Perangkat

Perangkat lunak yang digunakan dalam penelitian ini adalah :

- TcomportLib

Merupakan *add-on* atau paket tambahan untuk melakukan komunikasi secara serial dengan mikrokontroler.(gambar 4)
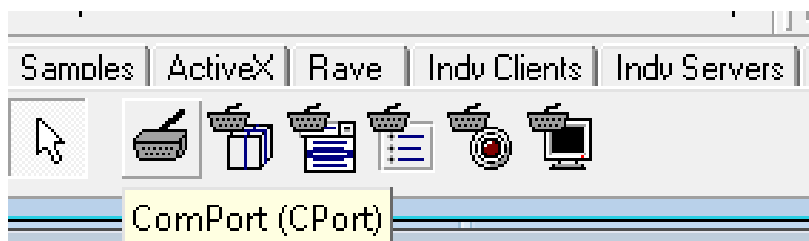
Gambar 4. Komponen Tcomport

- DBMS MySQL 5

Aplikasi ini digunakan untuk membangun struktur data yang akan digunakan pada BAS. Aplikasi ini dipilih karena pengkombinasiaannya dengan aplikasi Delphi 7 sangat mudah. Bahasa query pada MySql dapat langsung dikenal pada aplikasi Delphi 7 tanpa ada perubahan sintaks. Tidak seperti Ms Access ataupun Ms. SQL Server 2000 yang memerlukan modifikasi sintaks saat mengeksekusi query.

- MySql Front

Aplikasi ini adalah pelengkap aplikasi DBMS MySql 5. Bila pada MySQL 5 sintaks dituliskan dalam jendela DOS, maka aplikasi inin menyediakan antarmuka grafisnya sehingga memdudahkan dalam modifikasi struktur database.

- CodeVision AVR

Aplikasi ini digunakan untuk men-*download* program sederhana kendali ke mikrokontroler. Dasar bahasa pemrograman yang digunakan adalah C. dalam aplikasi ini telah tersedia fitur pembangkitan kode program sesuai kriteria mikrokontroler yang kita gunakan.

- Eagle layout editor

Dalam pembangunan BAS tidak terlepas dari perancangan antarmuka fisik seperti rangkaian mikrokontroler. Untuk itu digunakan aplikasi Eagle dalam perancangan *circuit board* yang dibutuhkan.

4. Hasil Perancangan

Rancangan system ini diperlihatkan oleh gambar 5 berikut.
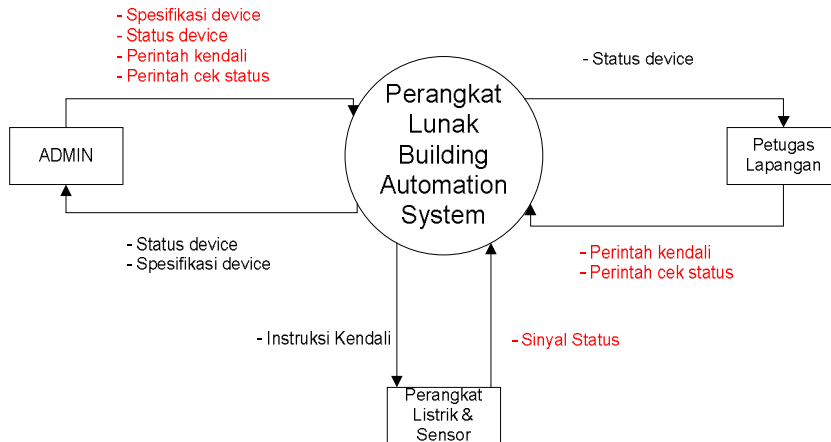
Gambar 5. Diagram Konteks BAS

Perangkat lunak BAS dalam penelitian ini dirancang untuk dapat melakukan :

1. Pemantauan operasi perangkat listrik yang menggunakan listrik secara terpusat.
2. Kendali operasi perangkat litrik secara terpusat.
3. Pencatatan dan perhitungan beban daya operasi perangkat.
4. Pemantauan keamanan gedung menggunakan sensor gerak yang disimulasikan dengan IRLED serta fototransistor.

Ilustrasi sistem pada penelitian ini diwakili oleh gambar 6. Pada sistem ini komputer tidak akan berkomunikasi (mengendalikan) secara langsung perangkat listriknya, karena port komunikasi yang terbatas di komputer dibandingkan jumlah perangkat yang akan dikendalikan. Oleh karena itu komputer akan dijembatani oleh mikrokontroler. Komunikasi antara komputer dan mikrokontroler menggunakan pola komunikasi serial yang menjadi *primary BUS*nya. Sedangkan *secondary BUS* adalah komunikasi antara mikrokontroler dengan perangkat keras. Pada dasarnya, komunikasi ini hanyalah menyatakan

status perangkat tersebut dalam keadaan ON atau OFF.

Komunikasi antara komputer dan mikrokontroler menggunakan komponen *Tcomport* untuk Delphi 7.

Sedangkan mikrokontroler yang digunakan adalah ATMega8535, dipilih karena banyak port yang bisa digunakan sehingga semakin banyak berangkat yang bisa dikendalikan.
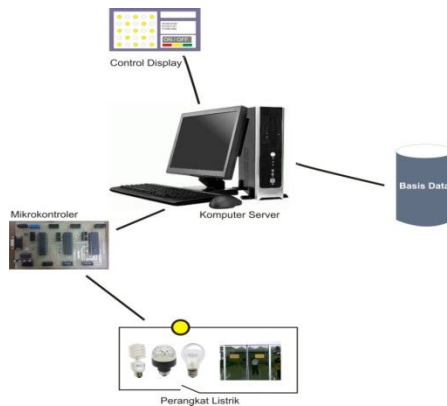
Gambar 6. Ilustrasi sistem.

Tabel 1. Flowchart komunikasi aplikasi dengan mikrokontroler
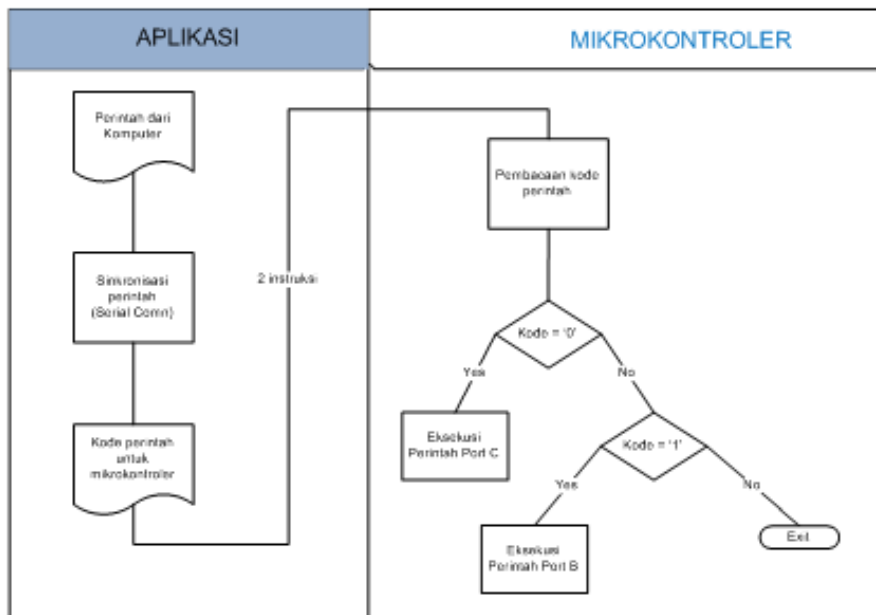
Antarmuka untuk pengguna berupa aplikasi desktop di komputer, pada aplikasi inilah kendali dan penjadwalan ditanamkan. Sedangkan jadwal sendiri disimpan ke dalam database. Database juga menyimpan data perangkat listrik. Perancangan basis data ditunjukkan pada tabel 2.

Tabel 2. Perancangan Data

Nama Tabel	Struktur Tabel	Key		Tipe Data	Lebar Data
		P	F		
LOKASI	Lokasi_ID	√		Varchar	5
	Lokasi_Nama			Varchar	20
	Lokasi_Lantai			Varchar	3
PERANG KAT	Perangkat_ID	√		Varchar	10
	Perangkat_Jenis			Varchar	10
	Perangkat_Mikrokontroler			Varchar	3
	Perangkat_Pin			Varchar	2
	Perangkat_Status			Varchar	3
	Perangkat_Kondisi			Varchar	5
	Perangkat_Beban			int	5
	Lokasi_ID		√	Varchar	5
JADWAL	Jadwal_ID	√		Varchar	3
	Jadwal_Nama			Varchar	10

Nama Tabel	Struktur Tabel	Key P	Key F	Tipe Data	Lebar Data
	Jadwal_Tipe			Varchar	10
	Jadwal_Wkt_On			Time	
	Jadwal_Wkt_Off			TIme	
	Jadwal_Tgl_Mulai			Date	
	Jadwal_Tgl_Akhir			Date	
PENJADWALAN	Perangkat_ID		√	Varchar	10
	Jadwal_ID		√	Varchar	3
	Lokasi_ID		√	Varchar	5
PENGGUNA	Pengguna_ID	√		Varchar	3
	Pengguna_Nama			Varchar	15
	Pengguna_KataSandi			Varchar	10
	Pengguna_Wewenang			Varchar	15
	Pengguna_Telepon			Varchar	14
	GP_ID		√	Varchar	5
GroupPengguna	GP_ID	√		Varchar	3
	GP_Nama			Varchar	15
	Perangkat_ID		√	Varchar	10

Nama Tabel	Struktur Tabel	Key		Tipe Data	Lebar Data
		P	F		
TRANSA KSI PEMAKAI AN	Indeks	√		autoinc	
	TP_On			Datetime	
	TP_Off			Datetime	
	TP_Pemakaian			Integer	
	Perangkat_ID		√	Varchar	10
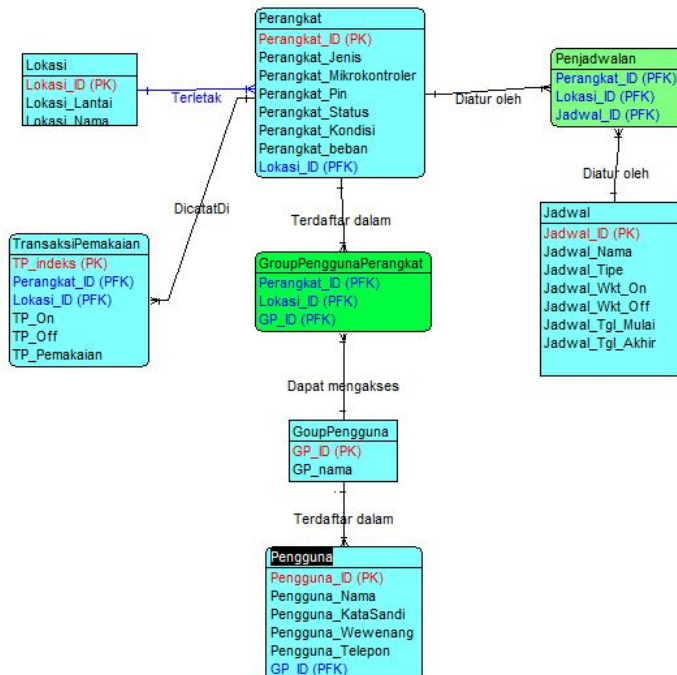
Gmbar 7. Perancangan Relasi

Circuit board hasil perancangan ditunjukaan pada gambar 8.
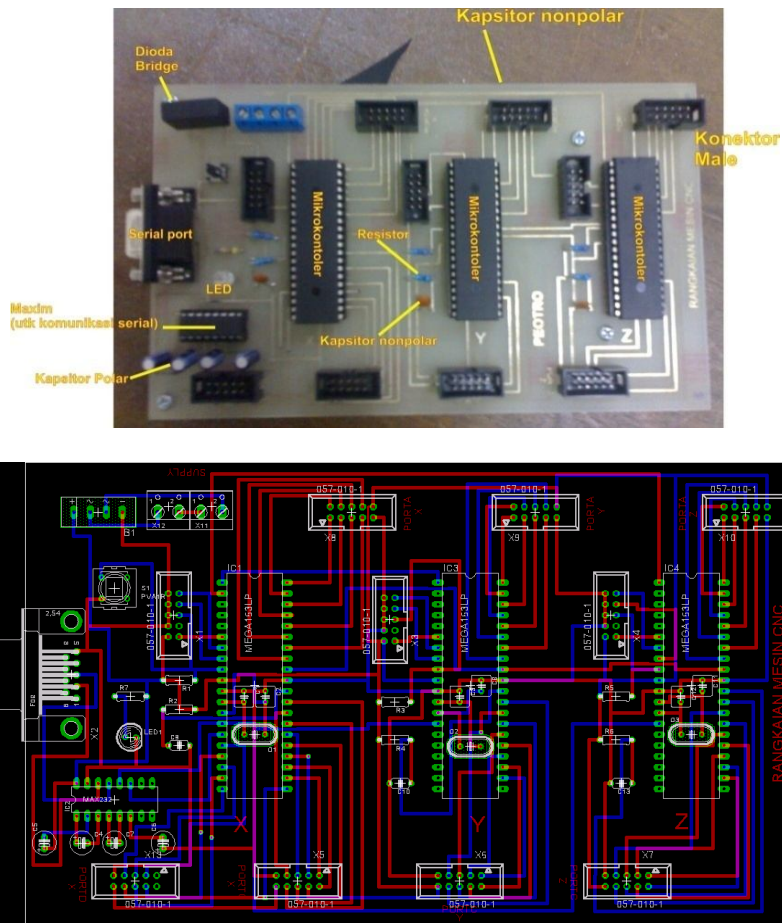
Gambar 8. Rancangan & Rangkaian microcontroler

Pada gambar 8 digunakan tiga buah mikrokontroler, bisa digunakan ketiganya atau salah satunya. Pada penelitian hanya digunakan satu mikrokontroler karena cukup untuk menangani gedung dua lantai dalam simulasinya. Untuk kendali, digunakan port B dan C, dimana tiap port ini memiliki 8 pin yang masing-masingnya menjadi titik kendali untuk tiap ruangan. Perintah kendali yang dikirimkan aplikasi ke mikrokontroler maksimal 8 bit atau 255. Gambar 9 menunjukan nilai untuk kendali tiap pinnya.

Gambar 9. Nilai instruksi tiap pin

Misalnya, kita akan menyalakan lampu di ruang rapat (dikendalikan pin 0) dan ruang staff (pin 7) maka aplikasi mengirimkan nilai '129'.

Berikut adalah *code* yang ditulis pada mikrokontroler:

```
{
    // Place your code here
    int a;
    a=getchar();
    if (a==0)
    {
     a=getchar();
     PORTC=a;
     cekSensor();
    }
    else
      if (a==1)
      {
            a=getchar();
            PORTB=a;
            cekSensor();
      }
      else
        if (a==2)
        {
            a=getchar();
            PORTD=a;
            cekSensor();
        }

    };        a=getchar();
     PORTC=a;
    }
    else
```

```
        {
        a=getchar();
        PORTA=a;
        }
        };
void cekSensor()
{
        int pantul;
        pantul=adc_data[0];
        // pantul < 300 = tidak terhalang
        if (pantul<300)
        {
            putchar('C'); //CLEAR
        }
        else
        {
            putchar('B'); //BLOCKED
        }
        delay_ms(10);
}
```

Seperti yang telah disebutkan sebelunnya, penelitian ini menggunakan maket untuk simulasi. Namun kendali perangkat listrik nyata (220v) telah dibuktikan. Dengan menambahkan satu perangkat sebagai saklar yang dikendalikan mikrokontroler tanpa merubah rancangan lainya yang telah dijelaskan. Rangkaian saklar ditunjukkan oleh gambar 10.
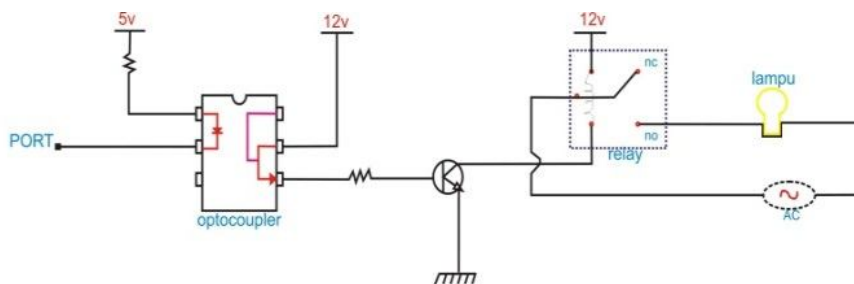
Gambar 10. Skema rangkaian saklar

Selain rancangan di atas, satu hal lagi yang perlu diperhatikan adalah perancangan algoritma untuk memeriksa jadwal mana sedang valid. Sebelumnya, jadwal dibagi ke dalam 4 tingkatan, terurut dari prioritas

tertinggi adalah :

1. Aksidental

Hanya dieksekusi satu kali, pada tanggal yang ditentukan.

2. Bulanan

Dieksekusi setiap tanggal yang ditentukan untuk setiap bulannya.

3. Mingguan

Dieksekusi setiap tujuh hari sekali.

4. Harian - Diseksekusi setiap hari

Dengan rancangan seperti ini, memungkinkan untuk membuat jadwal untuk jam kerja dan bukan jam kerja pada setiap harinya. Dan membuat jadwal libur setiap hari minggu. Setelah jadwal dibuat maka penjadwalan dapat dilakukan dengan menyandingkan perangkat-perangkat ke satu jadwal atau lebih. Berikut adalah diagram algoritma pengecekan jadwal valid.
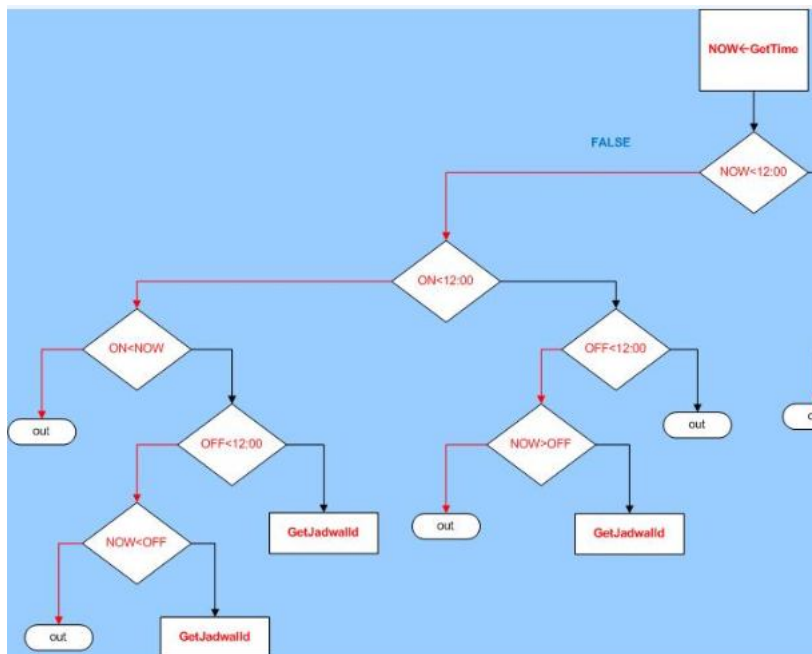
Gambar 11. Flowchart Pencarian Jadwal Aktif (bag 1)
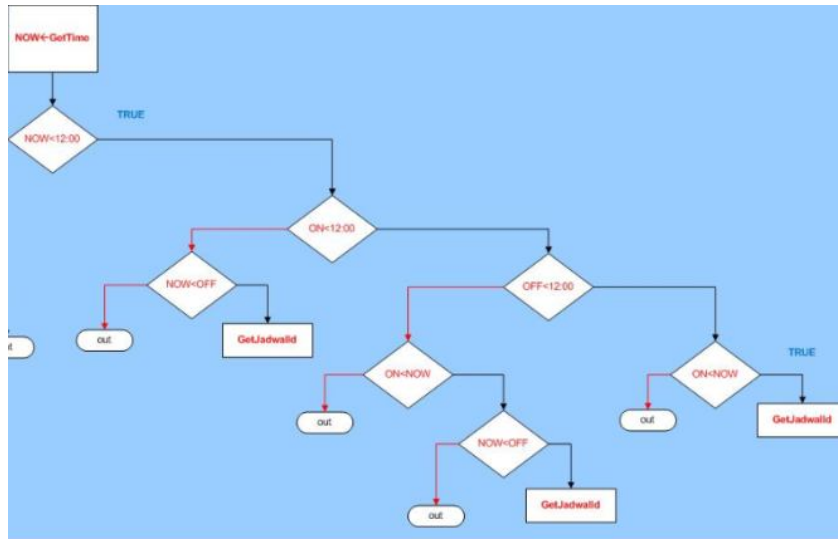
Gambar 12. Flowchart Pencarian Jadwal Aktif (bag 2)

Berikutnya adalah perancangan proses untuk sistem ini (gambar 13).
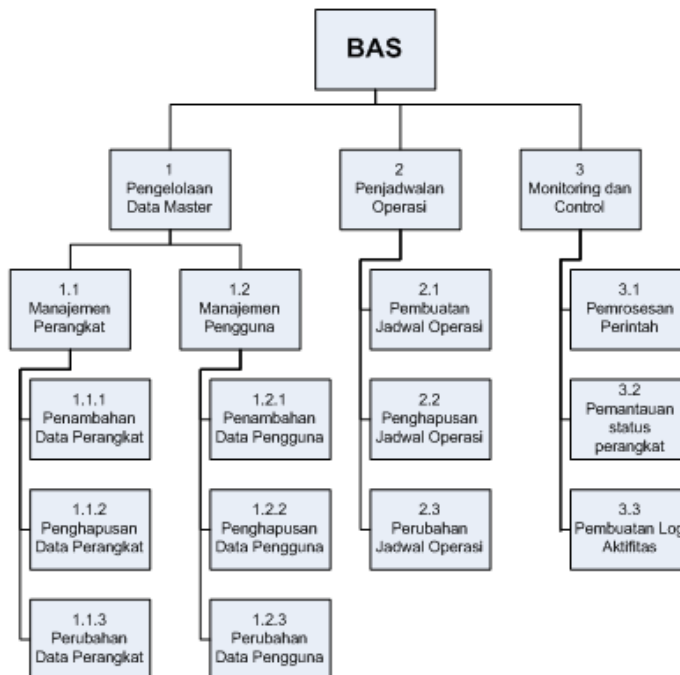
Gambar 13. Struktur proses

Tabel 3. Penjelasan prosedur Monitoring & Control

No	Proses	Fungsi
3.1	Pemrosesan Perintah	Perubahan status satu atau sebagian atau semua perangkat menggunakan display kendali.
3.2	Pemantauan Status Perangkat	Perubahan status satu atau sebagian atau semua perangkat melalui sms sehingga pengguna tidak perlu ada di pusat kontrol.
3.3	Pembuatan Log Aktifitas	Mencatat setiap aktifitas sistem secara berkala.

Pada tabel 3 baris terakhir, ada sebuah proses untuk pembuatan log aktifitas. Pada proses ini dihitung lama operasi tiap perangkatnya, yang kemudian bisa dihitung berapa beban listrik yang terpakai dikarenakan tiap perangkatnya telah dicantumkan daya yang dibutuhkan.

Adapun perancangan antarmuka interaksi aplikasi ditunjukkan pada gambar 13.

Gambar 13. Antarmuka pembuatan jadwal baru
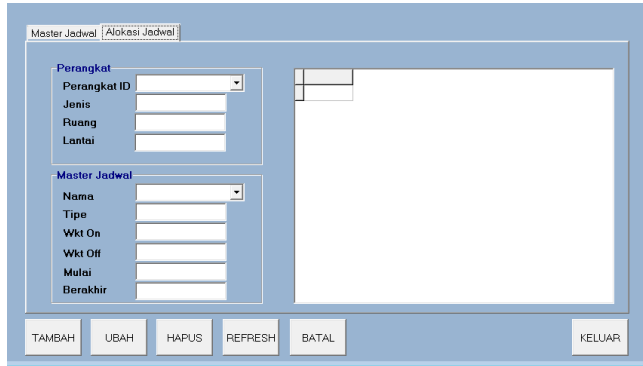
Gambar 14. Antarmuka untuk penjadwalan

Gambar 15. Antarmuka kendali tiap lantai

Antarmuka tiap lantai harus dibuat sesuai dengan layout gedung aslinya.
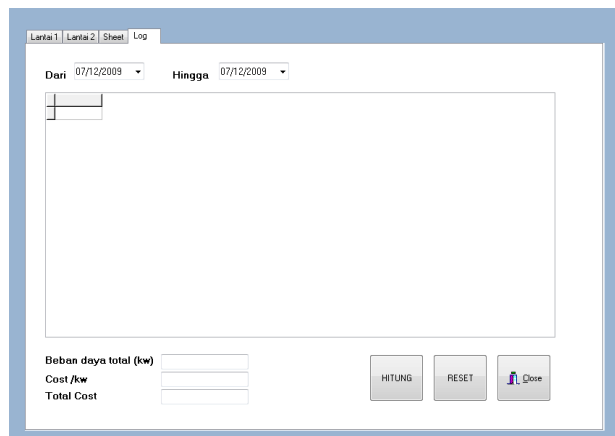
Gambar 16. Antarmuka pencatatan (log) aktifitas/penggunaan perangkat.

Pada gambar 16 dapat dilihat bahwa aplikasi dapat memberikan daftar alat-alat yang dipakai dalam rentang waktu tertentu dan juga lama pemakaiannya. Hal ini memungkinkan untuk menghitung berapa kWh daya yang dipakai. Dan dengan mengisi biaya kWh nya, dapat dihasilkan estimasi biaya listirk untuk waktu tersebut.

5. Kesimpulan
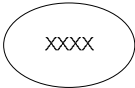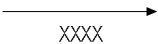
Berdasarkan hasil implementasi perangkat lunak BAS saat ini dapat diambil kesimpulan, bahwa:

- Penggunaan Mikrokontroler dapat menambah kemampuan monitoring dan kendali perangkat gedung yang menggunakan listrik dibandingkan dengan mengandalkan komunikasi menggunakan komputer langsung seperti pada Aplikasi Kendali Perangkat Listrik yang pernah dibangun sebelumnya.

- Aplikasi ini dapat memantau, mengendalikan dan menjadwal operasi perangkat yang menggunakan listrik.

- Aplikasi ini dapat mencatat penggunaan daya listrik dalam jangka waktu tertentu dan memberikan estimasi beban biayanya.

- Pada aplikasi ini, selain fungsi untuk pengaturan antarmuka, fungsi lainya telah bersifat *generic*.

- Aplikasi mampu menerima input dari perangkat keras seperti sensor IrLed, pada keadaan nyata bisa digantikan dengan sensor lainnya.

- BAS dapat meningkatkan efisiensi penggunaan energi listrik dengan penjadwalan operasi perangkat listrik di gedung.

6. Daftar Notasi

SIMBOL	KETERANGAN
xxxx	Menggambarkan sistem XXXX : Menyatakan nama sistem
xxxx	Menyatakan entitas luar XXXX : Menyatakan nama entitas luar
→ xxxx	Menyatakan aliran data atau informasi XXXX : Menyatakan nama aliran data atau informasi

7. Ucapan Terimakasih

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8. Daftar Pustaka

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FACULTY ENGINEERING

OF SHIZUOKA UNIVERSITY

JAPAN

Introduction to
Visible Light Communication

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1.   WHAT IS VLC?

Visible Light Communication (VLC) is a communication system using the visible light as a carrier.

VLC has many advantages as follows:

As shown in Fig.1, the visible light is very high frequency, therefore VLC has very strong tolerance to the radio wave interference. Besides, in Japan, the frequency of the visible light is beyond the limit of the frequency range regulated by the Radio Law. We can develop and use VLC without a license.

VLC allows to use a light source as not only the illumination but also the transmitter, which is called Illumination Communications. Illuminations are almost everywhere, therefore we can construct an ubiquitous network by using Illumination Communications.

Usually, it is difficult to transmit radio waves in the water, whereas visible light can be transmitted in the water. Therefore, VLC enables to do wireless communications in the water.

Visible light almost never has negative influence to human bodies and precision equipments, therefore we can use VLC in the environments that are strictly

limited to usage of radio wave such as hospitals, trains and planes.

Since the communication range of VLC is visible, we can control the communication range easily. By only blocking the light, we disconnect from the network.

VLC can use high electric power for transmission. Rapid spread of Light Emitting Diodes (LED) is one of the important reasons VLC begins to be attention. In the conventional illuminations, it is difficult to control switching on and off fast. In contrast, since it is easy to control switching an LED, VLC using an LED enables to do fast communication.

	300MHz
UHF (cellular phone, WLAN)	
	3GHz
SHF (satellite, ISM equipment)	
	30GHz
⋮	
	3THz
infrared light	
	400THz
visible light	
	750THz
ultraviolet light	
	10PHz
X-ray	
	3EHz

Fig. 1: The Frequency Classification in Japan

2. THE VLC ARCHITECTURES

Up to the present, the VLC architectures corresponding to the various purposes and the channel conditions have been proposed. These architectures are roughly classified into two categories. One serves only communication, and the other serves both illumination and communication. The former is demanded the communication performance to the channel condition, the latter has to be

considered, of course the performance, brightness and flicker to avoid vitiating the its role as the illumination.

3. TRANSMITTERS AND RECEIVERS

VLC can use not only an LED but also a visible light laser, an organic electroluminescence or an inverter fluorescent light as a transmitter. The VLC using an LED is more popular because it is versatile and inexpensive. As the receiver, VLC use a photodiode or an image-sensor because the carrier of VLC is visible.

The light reception range of a photodiode is very small, therefore in order to establish communication, Photodiode Communication demands very severe adjustment. However, this scheme allows Gigabit communication.

An image-sensor has very high spatial resolution, which means that the number of pixels of the image-sensor is the number of maximum channels.
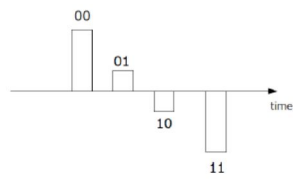
(a) Ordinary 4PAM
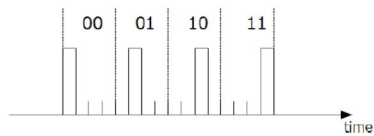
(b) 4PAM for VLC

Fig. 2: 4PAM

(a) 4PPM
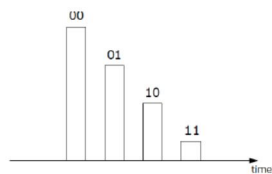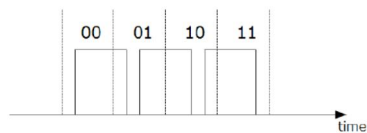
(b) I-4PPM

Fig. 3: 4PPM

Therefore Image-sensor Communication allows parallel communication. Moreover, this scheme has very strong tolerance for disturbance by eliminating another light sources from the received image.

However, the frame rate of the standard image sensor is 30 _ 60[*fps*], which is too slow to use it as the receiver. Nevertheless, Image-sensor Communication has been developed more popularly than Photodiode Communication, because Image-sensor Communication has above-mentioned unique features and most cellular phones are equipped with an image-sensor as a digital camera.
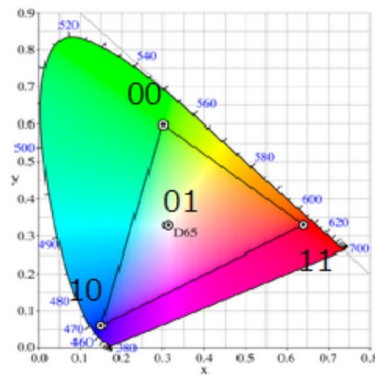
Fig. 4: The Constellation of CSK

4. MODULATION METHODS

In modulation of VLC, Pulse Modulation (PM), such as Pulse-Amplitude Modulation (PAM) or Pulse-Position Modulation (PPM), is adopted popularly.

Illumination Communication adopts particular modulations based on PM to avoid vitiating role of light as a illumination. In case of PAM, the transmitted signal is modulated by PAM applying appropriate bias voltage to ordinary PAM (Fig.2(a)) to gain sufficient brightness for the illumination.

As shown in Fig.3(a), in ordinary PPM, one of time slots is set at high and the others are set at low. Whereas in case of PPM for VLC, in order to gain sufficient brightness and avoid flickering, the selected time slot should be set at low and the

others are set at high. This modulation is called inverted-PPM (I-PPM, Fig.3(b)).

Besides shown as Fig.4, modulation in which information symbols are mapped on RGB color coordinate is proposed, which is called Color Shift Keying (CSK).

5. SCENES VLC IS AVAILED

Putting the features of VLC to good use, VLC is expected to be availed in following scenes.

5.1. Intelligent Transportation Systems, ITS

Today, many vehicle lights and traffic lights in Japan are equipped with LEDs, and cars are equipped its front and rear with cameras. Therefore, it is possible to do vehicle-to-vehicle communication or road-to-vehicle communication by using these equipments.

Fig. 5: Traffic Light Using LED

5.2. Augmented Reality, AR

Image-sensor Communication can detect the signal light in the received image. Then users can enjoy new image which is made by merging the received image and the received information.

Fig. 6: Received Image Overlaid with Received Information

5.3. Maritime Safety

Many lighthouses and floating lights are equipped with LEDs. Transmitting information such as positions of surrounding other ships by using their light as the carrier, VLC increases the maritime safety.
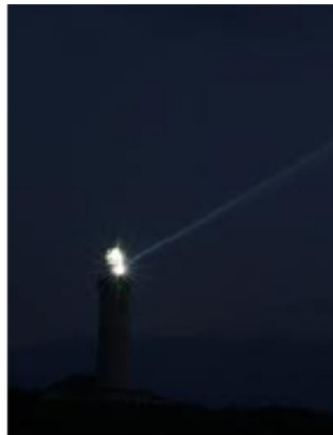
Fig. 7: Lighthouse Using LED

5.4. Inter-diver Communication

In the water, it is very difficult to use radio wave for communications. However divers can communicate with each other wirelessly in the water by using VLC.

6. INTRODUCTION TO MY STUDY

I have constructed parallel transmitting VLC system using an LED matrix panel (Fig.9) and a USB camera (Fig.10). In my system, the LED panel is controlled by a Peripheral Interface Controller and transmitted information by expressing

Fig. 8: VLC Enables Inter-diver Communication
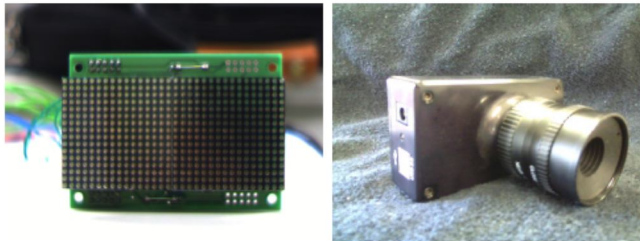
Fig. 9: LED Matrix Panel Fig. 10: USB Camera

"1" by ON and "0" by OFF. It is embedded with 512 LEDs, therefore maximum transmission bits is 512 bits per frame. Since the frame rate of this USB camera is 60[fps], the maximum bit rate is 30720[bps].

The receiver gets information by digital image processing of the received images. Firstly, we convert the received image (Fig.11) into the binary image (Fig.12) to simplify the later processes. Next, we detect the position of the LED panel in the binary image. Then, we expand the area of the LED panel in the binary image (Fig.13). Finally, by dividing the expanded image into the number of signals

(Fig.14), one of the divided spaces is called cell, we judge state of LEDs as ON or OFF by referring to the number of white pixels in each cells.

Fig. 11: Received Image
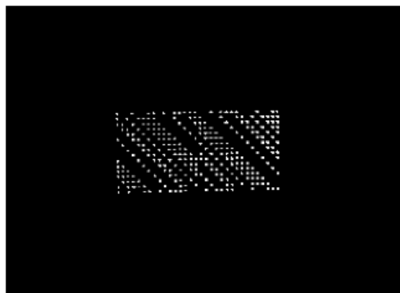
Fig. 12: Binary Image
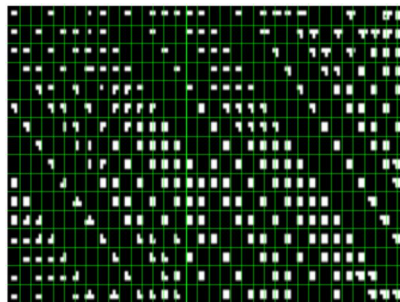

Fig. 13: Expanded Image

Fig. 14: Divided Image

7. REFERENCES

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[2] Visible Light Communication Consortium HP, URL: http://www.vlcc.ne

Implementation of Wireless Telecommunications System using GNU Radio/USRP2

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1. Abstract

The operation verification and the performance assessment of researches of various protocols of wireless ad-hoc networks and sensor networks are mainly done by the computation simulation. And, it is necessary to implement the protocols because, by measuring performance of them under real environment, we can check the validity of the result of the computer simulation.

Usually, since each protocol needs its own hardware, we have to prepare many hardwares to evaluate all proposed protocols, which requires much cost and time. Given this situation, SDR (Software Defined Radio) is attracting attention recently. SDR is a wireless machine that can change the physical layer processing of the wireless telecommunications only by rewriting software. That is, it is a wireless machine that can correspond to many wireless telecommunications systems without changing hardware. The SDR that combines GNU Radio with USRP2 (Universal Software Radio Peripheral) is used for our research. The GNU Radio is a software development tool for SDR and USRP2 is a general-purpose signal processing hardware. General SDRs need a special development setting and licence, but GNU Radio is licence-free. Thus, it has many attentions from both industries and academics because of the ease of deployment and the ease of use.

In our study, we implement a wireless telecommunications system to GNU Radio/USRP2, and examine the effect of the system under real environment.

2. GNU Radio & USRP2

GNU Radio is a freeware for the SDR was developed as part of the GNU Project. There are some module programs which describe modulation methods and are written by C++. In order to integrate the module programs, a contorol program which is written by Python should be prepared. USRP2 is hardware developed as a front end for GNU Radio, and it operates by connecting PC by Gigabit Ethernet. The radio frequency band can be changed by the daughter board which correspond to desired frequency.

The frequency, 2.4GHz and 5.1GHz, and the overhead power of the daughter board used in our study passed the registration check by the Regional Bureau of Telecommunications, Japan. The GNU Radio/USRP2 can be used for other purposes, e.g., frequency spectrum observation, cognitive radio and a teaching material for the radio communication education.

3. Implementation of Network Coding

We now take up network coding(NC) as one of the wireless telecommunications techniques that can achieve high throughtput. A relay node combines reception packets from two or more terminals by XOR operation and forwards the combined packet to the entire network. An example of the network coding is shown in Figure 1, and the photo of the experiment is shown in Figure 2. It is thought that channel condition between terminals greatly influences the characteristic when NC is used for mobile telecommunications or the small wireless sensor terminal.
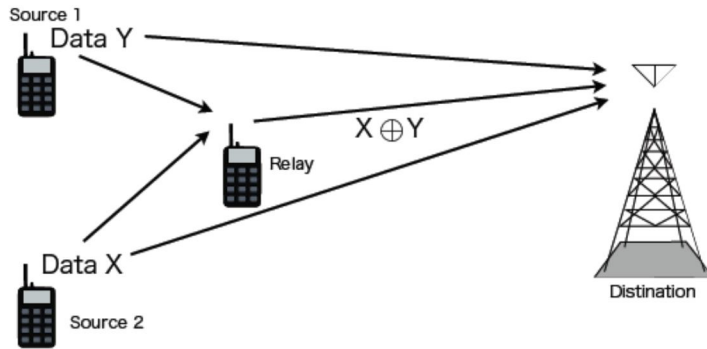
Fig. 1 An example of Network Coding

Therefore, evaluation under real environment with an SDR becomes important. Performance of NC is shown in Figure 3. The performance of NC that obtained from this experiment has a similar tendency as the performance obtained from the computation simulation.
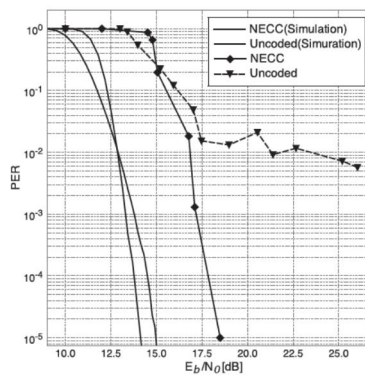

Fig. 2 An example of Network Coding

Fig. 3 Performance of NC

An introduction to Meteor burst communication

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1. Introduction

Meteors are space dust particles entering the earth's atmosphere. Most of the meteors cannot be seen by naked eyes. However billions of tiny meteors enter the earth's atmosphere daily.

When the meteors enter the earth's atmosphere, an ionized gas column (meteor burst) is generated at the height of about 100 kilo meters. The typical length of the meteor bursts is several tens kilo meters. Those disappear in a few seconds due to diffuse. A meteor burst during it exists works as reflection medium of radio waves in the low VHF band (30-100MHz) and enables over-the-horizon communication between two stations within 2,000 kilo meters.

Meteor Burst Communication (MBC) is a system for over-the-horizon communication, utilizing signal propagation from the meteor bursts. Figure 1 illustrates an example of MBC. A radio wave in a low VHF band from a transmitter is reflected at the meteor burst and reaches a receiver. MBC is unsuitable for communication required immediacy because of the randomness of the generation of meteor bursts and the diffusion of the meteor bursts. However if the system has small capacity and the delay is allowed, MBC has advantages, for example, simplicity of construction and operation of the system, easiness of automatic operation, economic

efficiency, and difficulty of interruption. Existing and proposed applications of MBC include meteorological data acquisition, remote monitoring, and vehicle tracking.

2. Type of meteor bursts

Meteor bursts are roughly classified into "underdense burst" and "overdense burst" according to reflectance properties. The reflectance variations of the underdense burst and the overdense burst are shown in Figures 2 and 3, respectively.
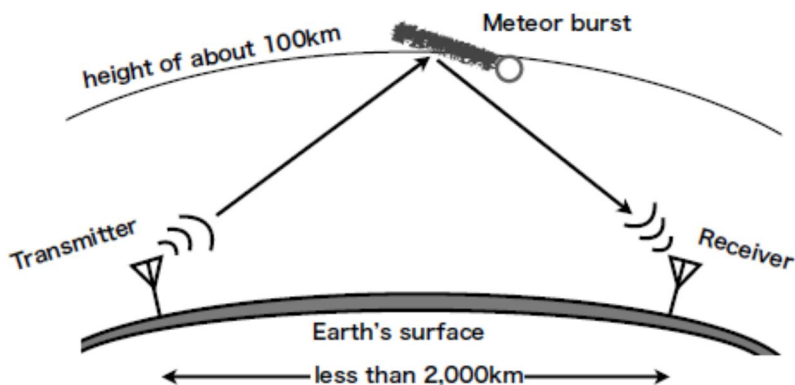

Figure 1: Meteor burst communication

On the underdense burst, the received power becomes a peak when the meteor burst occurs and attenuates exponentially with time. On the overdense burst, duration time of the channel is relatively long.

A difference of reflectance properties relies on electron density of the meteor burst and this border value is about 2_1014[electrons/m]. This value of electron density corresponds to the meteor burst generated by a space dust particle of one severalth milligram. The number of meteors is inversely proportion to the weight of space dust particles. Therefore most of the meteor bursts are underdense burst.

3.   Properties of the meteor burst channel

In MBC, radio wave in the VHF band is used because interference by ionospheric reflection is little. When we use higher frequency, we obtain lower reflection intensity.

Among a great number of meteors entering the earth's atmosphere, only those entering at proper location and correct orientation support communication between two specific points. From a past experiment, it is known that the generation interval is Poisson process. Average generation interval is tens of seconds. Generation interval depends on transmit power, antenna beam width, frequency, and receiver sensitivity.
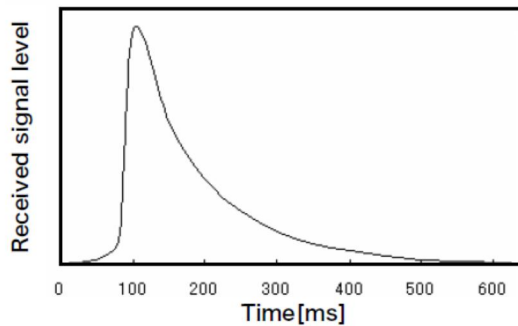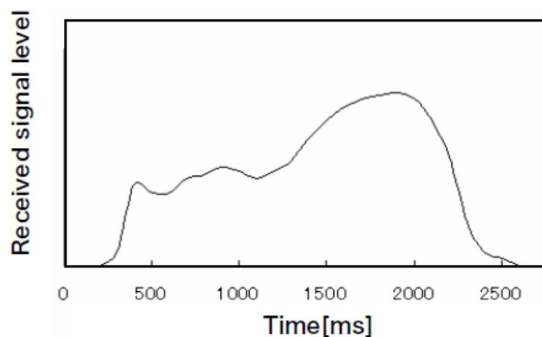
Figure 2: Underdense burst

Figure 3: Overdense burst

Duration time of the meteor burst channel depends on system parameters such as transmit power, frequency, and antenna gain. Moreover it differs greatly by the type of meteor bursts. It is known that channel available time approximately has an exponential distribution. Generation of meteor burst channel and its duration time are probabilistic. However during the channel exists, it is stable.

4. The transmission control proto-col

Many of systems utilizing MBC are data acquisition system, that is, a master station collects data such as whether information from many remote stations. Figure 4 illustrates the typical transmission control protocol of the data acquisition system utilizing MBC. The description of the protocol is as follows:

1. The master station transmits probe packets (PP) at constant interval.
2. When the MBC channel between the master station and a remote station opens and the remote station receives a probe packet, the remote station transmits a data packet from its transmission queue.
3. When the master station receives the data packet, the master station returns an ack (acknowledge) packet including the remote station number.
4. When the remote station receives the ack packet including its remote station number, the remote station discards the data packet which was already transmitted.
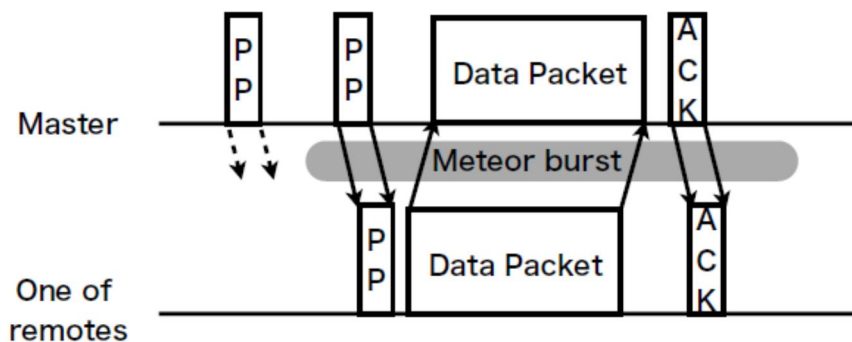
Figure 4: MBC protocol

5. The research contents

Most of the meteor bursts are the underdense burst. On the underdense burst, received power attenuates exponentially with time as Figure 2. Hence the latter part of the packet is influenced by noise than the former part. Therefore the latter part of the packet may include errors. In conventional Automatic Repeat reQuest (ARQ) schemes, even if errors occur only in the latter part, whole of the packet is discarded.

In MBC, which has very short communication period, the influence by this loss is serious. To overcome this problem, we propose a new ARQ scheme named Go Back i-symbol ARQ (GBi-ARQ) scheme which can achieve symbol-wise retransmission by using a convolutional encoder and a Viterbi decoder. The concept of the GBi-ARQ scheme is shown in Figure 5. In this proposed scheme, only the latter part of the packet including errors is discarded and retransmitted. Communication efficiency is improved by using the proposed scheme. Figure 6 shows the performance of the proposed scheme and the conventional scheme by computer simulations. The vertical axis represents amount of transmitted bits per burst. The horizontal axis represents initial signal-to-noise ratio. From the figure, the proposed scheme exhibits better performance than the conventional scheme. We are researching aiming at the further improvement of performance of the proposed scheme.
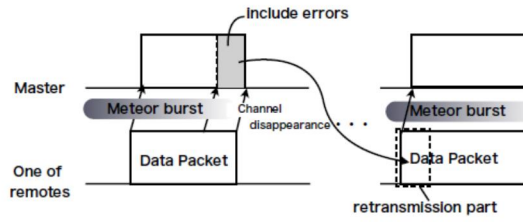
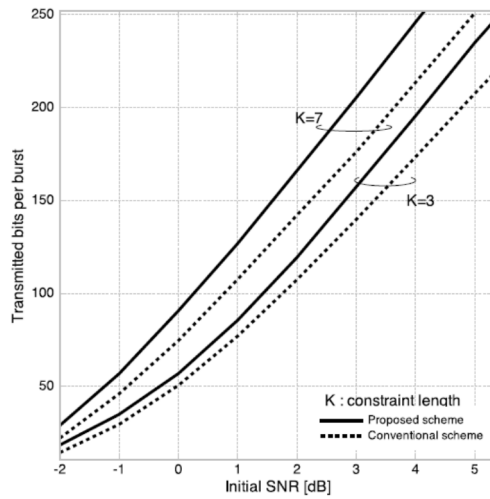Figure 5: Concept of GBi-ARQ scheme in MBC Channel

Figure 6: Performance comparison between proposed scheme and conventioinal scheme

Development of Ship Collision Warning System using Mote Terminals

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1.   Introduction

Ship Collision Warning System is a system that raises alarms when there is fear of collision of ships. Although a radar and GPS are usually used with this system, they are expensive for the individual use. To prevent collisions of ships, a warning system should spread widely and thus it is necessary to develop an inexpensiveness and reliable system.

In this paper, the collision warning system that uses the RSSI (Received Signal Strength Indication) measurement function of IRIS Mote is proposed. IRIS Mote is a terminal used for WSN (Wireless Sensor Network) and not expensive for the individual use. By this method, we can roughly measure a distance between two ships by checking power of the electric wave.

2.   IRIS Mote

IRIS Mote is a wireless terminal for the sensor network developed by Crossbow Technology Co. in the United States, and it conforms to IEEE802

.15.4. By using IRIS Mote, we can easily construct ad-hoc multi-hop power saving communication networks by using Tiny OS, which is small OS for the sensor terminal. The following table show the specification of IRIS Mote.

Table 1. Specification of IRIS Mote

CPU	Program Memory	Data Memory	Frequency band	Power source
Atmega 1289	128KB	512KB	2.4GHz	Two AA Batteries
Consumed Power(high)	Consumed Power(low)	Transmission speed	size	
18mA	300μA	250kbps	62X35X 27mm	

3. Principle of Distance Measurement

To obtain a distance between two terminals, we use the Friis Transmission Formula (Eq. (1)) that is an important formula for design and evaluation of the propagation of an electric wave. We also use the Two-Ray Model (Eq. (2)), which is also an important formula and expresses the effect of combination of a direct wave and a reflected wave. By assuming the parameters GT, GR, PT, _, _ shown in Table 2, the relation between the Received Power, PR, and the distances, d, $r1$ and $r2$, can be obtained.

$$P_{Rf} = \left(\frac{\lambda}{4\pi d}\right)^2 G_T G_R P_T \tag{1}$$

$$P_R = P_{Rf}|1 + R(\theta)e^{j\frac{2\pi(r_2 - r_1)}{\lambda}}|^2 \tag{2}$$

Table 2. Parameter Values

Antenna Height	Gain	Transmit Power	Wave length	Reflection Coefficient
hT, hR	GT, GR	PT	λ	$R(\theta)$
0.76[m]	2[dBi]	2[mW]	0.13[m]	-1

We can estimate a rough distance between terminals by applying Eq. (3) that is calculated from Eqs.(1) and (2) to the RSSI value, PR, that is obtained from the

RSSI measurement function of the IRIS Mote. The lower form of Eq. (3) can be given by an approximation of Eq. (2) by assuming d as large.

$$\hat{d} = \begin{cases} \frac{\lambda}{4\pi} \left(\frac{G_T G_R P_T}{P_R} \right)^{1/2} & P_R \geq \left(\frac{\lambda}{4\pi} \right)^4 \frac{G_T G_R P_T}{(h_T h_R)^2} \\ \sqrt{h_T h_R} \left(\frac{G_T G_R P_T}{P_R} \right)^{1/4} & P_R < \left(\frac{\lambda}{4\pi} \right)^4 \frac{G_T G_R P_T}{(h_T h_R)^2} \end{cases} \quad (3)$$

4.   Experiment Results

In this study, I have carried out some experiments using two terminals. At first, the two terminals are set at 100[m] apart and then one of them moves to the other with a fixed velocity.

Fig. 1 shows an example of the result of RSSI. The dashed line is a theoretical value of Two-Ray Model and the solid line is the measurement result of RSSI. It can be understood that the result tends to follow the theoretical value to some degree. Fig. 2 shows the estimated distance from Eq. (3) by using measured RSSI value. The dashed line is the true distance and the solid line is an estimated distance. The estimated distance increases by the increase of the true distance, i.e., the proposed scheme can be used for roughly estimation of the distance. But we can also find a nonnegligible difference between the estimated true values. The reasons of this difference is the transmission loss of antennas and the transmission line of IRIS Mote. The study for accurate distance measurement is required.
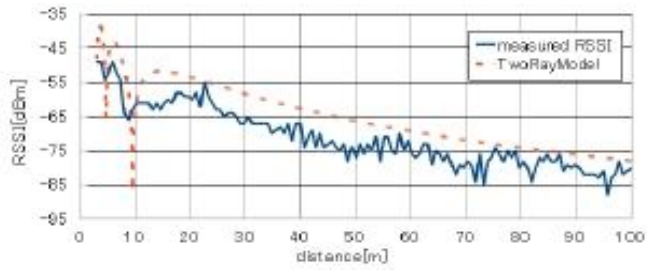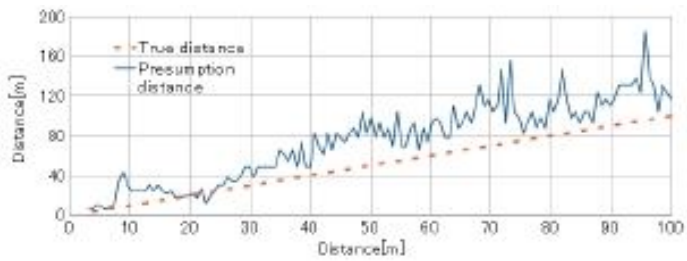
Fig. 1: Result of RSSI Measurement

Fig. 2: The Estimated Distance