


## DEVELOPMENT OF INTELLIGENT SOFTWARE FOR EARLY DETECTION OF STUNTING IN TODDLERS BASED ON ANTHROPOMETRY

Sri Widodo<sup>1</sup>, Anik Sulistiyanti<sup>2</sup>  
Duta Bangsa Surakarta University<sup>1</sup>, Duta Bangsa Surakarta University<sup>2</sup>  
Email: sri\_widodo@udb.ac.id<sup>1</sup>, anick\_yo@ymail.com<sup>2</sup>

ARTICLE INFO	ABSTRACT
Received: Revised: Approved:	<p><i>The state of chronic malnutrition, during development, since early life, can describe the state of stunting. The state of stunting is indicated by the z-score of height (H) for age (A) (H/A) less than -2 standard deviations (SD). In Indonesia, doctors and midwives, to find out the presence of stunting in children using the Health Card. The way that is done is to weigh the toddler every month. The weighing results are recorded in the Health Card, between the weight points of last month's weighing and this month's weighing results are connected by a line. The child's growth is shown by the graph formed on the Health Card. If the growth chart is below the normal limit line, it can be said that the child is indicated to be stunting. The manual method used is less effective and efficient. In addition, the results obtained by midwives are less accurate in determining stunting status in toddlers. In accordance with the problems above, we conducted research on the development of an application for early detection of stunting in toddlers based on anthropometry using an intelligent system. The research conducted consists of three main things. These three things are applications for managing children's medical record data, intelligent applications for early detection of stunting using the Support Vector Machine (SVM), and finally a graphic application for integrating anthropometric data for toddlers. With this application, midwives and health cadres can detect stunting in toddlers easily and accurately.</i></p>
<b>KEYWORDS</b>	Anthropometry, Health Card, Stunting, SVM
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### INTRODUCTION

The state of chronic malnutrition, during development, since early life, can describe the state of stunting. The state of stunting is indicated by the z-score of height (H) for age (A) (H/A) less than -2 standard deviations (SD) based on growth standards according to WHO (WHO, 2010) [1]. Around 1 in 4 children under five in the world is

stunted (UNICEF, 2013) [2]. In Indonesia, in 2013 there were 37.2% of children under five who experienced stunting, based on the results of the 2013 Basic Health Research (Riskesdas) [3]. From this percentage, the number of short children is around 19.2% and very short children is around 18.0%. Compared to the results of Riskesdas in 2010, the prevalence of stunting increased by 35.6%. Stunting detection is very necessary to describe chronic malnutrition status during growth and development since early life. This is because toddlerhood is a period that is very sensitive to the environment. The state of stunting is indicated by the z-score of height (H) for age (A) (H/A) less than -2 standard deviations (SD) on growth standards according to WHO (WHO, 2010) [1]. Globally, about 1 in 4 children under five is stunted (UNICEF, 2013) [2].

The current method used to find out the presence of stunting in children using the Health Card. The way that is done is to weigh the toddler every month. The weighing results are recorded in the Health Card, between the weight points of last month's weighing and this month's weighing results are connected by a line. The child's growth is shown by the graph formed on the Health Card. If the growth chart is below the normal limit line, it can be said that the child is indicated to be stunting. In addition, midwives can differ from one another in determining the status of stunting in toddlers.

Several studies on stunting have been carried out. These studies include the research of Kukuh Eka Kusuma [4]. Observational research with case-control design on toddlers aged 2-3 years in the district of East Semarang. Sampling was done by consecutive sampling, 36 subjects in each group. Stunting is categorized based on the z-score of height for age (TB/U). Data on subject and respondent identity, birth length, parents' education, parent's occupation, family income and number of family members were obtained through interviews with questionnaires. Data on children's heights and parents' heights were measured using a microtoise. Bivariate analysis using Chi-Square by looking at the Odds Ratio (OR) and multivariate with multiple logistic regression. Results: The results of the multivariate analysis showed that the risk factor for stunting in children aged 2-3 years was low family economic status ( $P = 0.032$ ;  $OR = 4.13$ ), while birth length, parental height, and parental education were not factors. risk factors for stunting.

The second research is research from Khoiru Ni'mah [5]. The purpose of this study was to determine the factors associated with the incidence of stunting in children under five. This research is an analytical observational study with a case-control design conducted in the working area of Tanah Kali Kewall Health Center, Surabaya. Samples were taken as many as 34 children under five for each group of cases and controls with simple random sampling technique. The results of the study were that there was a relationship between birth length of toddlers, history of exclusive breastfeeding, family income, mother's education and knowledge of maternal nutrition on the incidence of stunting in toddlers.

The next research is research from Ningki Hermaduanty (2008) [6] who conducted research on SMS-Based Decision Support Systems to determine Nutritional Status with the K-Nearest Neighbor Method by using this application users can find out their nutritional status with fast, easy and inexpensive alternatives. . This study shows the accuracy of the system is 90.41 %. The next research is research on Cards Towards Health from Adi Wicaksana (2011) [7], who designed the Health Cards in East Java Province using the Weighted Spline Model. The background of this research is that the Health Cards currently used in Indonesia does not describe the growth pattern of children under five, especially in East Java. Based on the growth curve of children under five in East Java Province, there is a change in the pattern at a certain age and also the error variance is not constant. Health Cards designed with a weighted spline regression approach has a lower evaluator standard than the KMS used in Indonesia today. Previously, in 2002 in Malawi, a development of an Integrated Nutrition and Food Security Surveillance (INFSS) has utilized SMS

technology by building an SMS gateway called RapidSMS. RapidSMS has succeeded in reducing costs significantly when compared to paper-based surveillance [8].

From the description above, it can be seen that most of the research conducted is limited to the analysis of stunting. Research related to application development is mostly about Cards Towards Healthy Toddlers. Research related to the development of stunting detection software is still rarely carried out by several researchers.

Therefore we need an application that can detect early failure to grow (stunting) automatically. While the research to be carried out is to develop software for early detection of stunting in toddlers using an intelligent system. The research conducted consists of three main things. These three things are applications for managing children's medical record data, intelligent applications for early detection of stunting using the Support Vector Machine (SVM), and finally a graphic application for integrating anthropometric data for toddlers. This application is expected to help midwives, as a second opinion in early diagnosis of stunting symptoms. Smart applications developed using the Support Vector Machine (SVM) method can be used as a model to detect stunting status in children. It is known from the average value of accuracy obtained by 86%.

## RESEARCH METHOD

This study uses a guided classification method. Therefore, it requires training data and testing data. training data is data that will be used in the classification process. The training data used were taken from the anthropometry of boys and girls under five according to the World Health Organization (WHO) which includes data on age, weight and body length [1]. While the test data is the data of the results of the inspection every month from the Posyandu. The testing data came from Posyandu Sejahtera Badran, Ponowaren, Tawang Sari, Sukoharjo, Central Java, Indonesia. The data taken include medical records of toddlers and anthropometry of boys and girls including: age, weight and body length. The development of early detection software for automatic growth failure (stunting) can be explained as follows:

### a. Database Development

The first stage of the developed application is an application for managing toddler medical record data. The purpose of developing a medical record application is so that the medical record data of babies from birth to the age of five years can be well documented, including the nutritional development status of toddlers. The form for entering children's medical record data can be seen in Figure 1 below.

INPUT MEDICAL RECORD DATA	
No. MR	<input type="text"/>
Name	<input type="text"/>
Date of Birth	<input type="text"/>
Age	<input type="text"/> Month
Weight	<input type="text"/> Kg
Height	<input type="text"/> Cm
Head Circumference	<input type="text"/> Cm
Mother's Name	<input type="text"/>
Inspection Date	<input type="text"/>
<input type="button" value="Save"/> <input type="button" value="Edit"/> <input type="button" value="Delete"/> <input type="button" value="Exit"/>	

Figure 1. Form Design For Toddler Medical Record Data Input

b. Development of Stunting Early Detection Method Using Intelligent System.

Smart application for early detection of stunting based on age, weight and body length using the Support Vector Machine method. The stages of the stunting early detection process using the Support Vector Machine can be explained as follows:

1. Collecting Data From Posyandu

Data collection was carried out in two Posyandu. The data taken includes data on the results of weighing toddlers in the form of medical record data for toddlers. The data taken include name, age, gender, weight and body length.

2. Feature Extraction

The process to obtain accurate information so that the identification or classification process can be carried out by a feature extraction process [10],[11]. Features of age, weight and body length are the features used to detect stunting in toddlers. The output of the classification process is Stunting Toddler and Normal Toddler based on the features used.

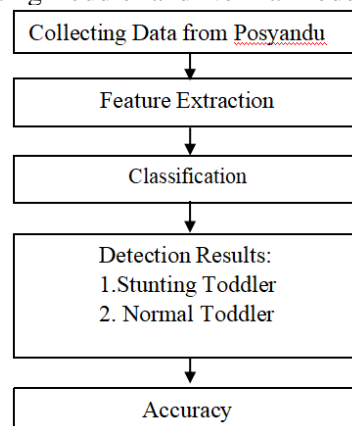


Figure 2. Stages of the Stunting Early Detection Method

3. Early Detection of Stunting

The classification process is a process used for early detection of stunting. The classification method used in this study is the Support Vector Machine (SVM) [9]. The result of this process is the index value of the largest decision function which states the class of the test data. If the class resulting from the test classification process is the same as the test data class, then the acknowledgment is declared true. The outputs produced are stunting toddlers and normal toddlers that match the value of the decision function index using the SVM method. Figure 3 shows the developed application



Figure 3. Program Interface

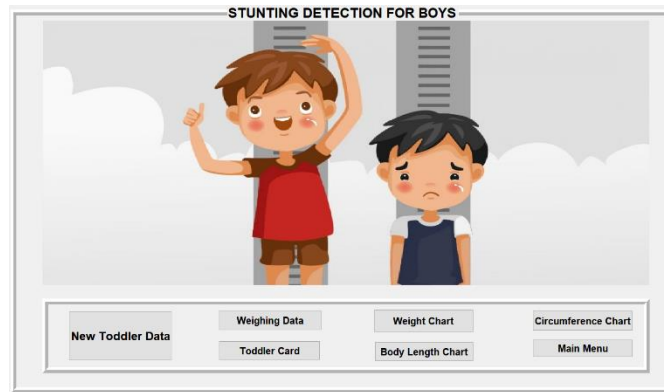


Figure 4. Stunting Detection for Boys

Examples of decisions resulting from the stunting detection process can be seen in the image below.



Figure 5. Example of Stunting Toddler Display



Figure 6. Example of a non-stunting toddler

#### 4. Calculating Nutritional Status Detection Accuracy

To get the value of accuracy is done by comparing the results of the classification by the system with groundtruth (midwife). The method used to calculate accuracy is the Receiver Of Characteristic (ROC) method. The ROC method will produce four values, each of which is true positive, false negative, false positive, and true negative. Stunting status that is correctly identified according to its class is indicated by True Positive (TP). Stunting status that must be correctly identified in its class, but in the classification process is incorrectly identified is indicated by a Positive Flase (FP). True Negative (TN) is a stunting status that is not a member of the identified class, and is identified as not a member of that class. A false negative (FN) indicates a stunting status that should not belong to a class, and is identified as a member of that class. Based on these four values, a true positive rate (TPR) value is obtained, which is known as sensitivity.

## RESULT AND DISCUSSION

Intelligent applications are developed using supervised methods, so training data is needed for the classification process. Training data used as much as 240 data. The training data used can be explained as follows. Training data from 0 to 59 are normal babies, 60 to 119 stunting data, 120 to 179 data for severely malnourished toddlers and 180 to 240 overweight toddlers. The features of age, weight and body length are features used to detect stunting status. To test the accuracy of the developed application, three tests were carried out using 50 testing data. The first test is testing the stunting detection method based on age and weight. The second test is based on age and body length. While the third trial is testing the stunting status based on age, weight, body length at the same time. This scenario is used to see the effect of feature selection in this case age, weight and body length on the performance of the developed stunting detection method. The results of the first test showed an accuracy rate of 85.1%. The results of the second test show an accuracy rate of 86% . The results of the third test show an accuracy rate of 82.3.6%. This shows that the method used using training data can be detected very accurately. The results of the tests that have been carried out can be seen in Table 1.

Table 1. Results of Testing

Amount of Data	Accuracy			
	Testing 1 (Weight/Age)	Testing 2 (Height/ Age)	Testing 3 (Head Circumference/ Age)	Testing 4 (W,H,H C/Age)
60	85.1%	86%	90.6%	82.3%

## CONCLUSION

After several tests, the author can conclude that the software to detect the stunting status of children using the Support Vector Machine (SVM) method can be used as a model to detect the stunting status of children..

## REFERENCES

WHO. (2010). Nutrition landscape information system (NLIS) country profile indicators: Interpretation guide. Geneva: World Health Organization.

UNICEF. (2013). *Improving child nutrition, the achievable imperative for global progress*. New York: United Nations Children's Fund.

Departemen Kesehatan Republik Indonesia. (2013). *Laporan Riset Kesehatan Dasar tahun 2013*. Jakarta: Balitbangkes.

Kukuh Eka Kusuma, Nuryanto, (2013), Faktor Risiko Kejadian Stunting Pada Anak Usia 2-3 Tahun (Studi di Kecamatan Semarang Timur), *Journal of Nutrition College*, Volume 2, Nomor 4, Tahun 2013, Halaman 523-530.

Khoirun Ni'mah, (2015), Faktor Yang Berhubungan Dengan Kejadian Stunting Pada Balita, *Media Gizi Indonesia*, Vol. 10, No. 1 Januari–Juni 2015: hlm. 13–19.

Hermaduanty, Ninki & Kusumadewi, Sri. Sistem Pendukung Keputusan Berbasis SMS untuk Menentukan Status Gizi dengan Metode K-Nearest Neighbor. Disampaikan pada Seminar Nasional Aplikasi Teknologi Informasi 2008. Yogyakarta.

Adi Wicaksono (2011), *Model Spline Terbobot Untuk Merancang Kartu Menuju Sehat (KMS) Propinsi Jawa Timur*, ITS Surabaya.

Blaschke, et al. (2009), *Using Mobile Phone to Improve Child Nutrition Surveillance in Malawi*. UNICEF Malawi and UNICEF Innovations.

Nugroho, A.S., Witarto, B.A., Handoko, D., (2003), *Support Vector Machine –Teori dan Aplikasinya Dalam Bioinformatika*, Kuliah Umum Ilmu Komputer.com.

Arif Muntasa, Muhammad Hariadi, Mauridhy Hery Purnomo (2009), *A new Formulation of Face Sketch Multiple Features Detektion Using Pyramid Parameter Model dan Simultaneously Landmark Movement*, *International Journal of Computer Science Network and security*, Vol 9.

Duda, R., Hart, P., and Stork, D. (2000), *“Pattern Clasiffication”*, Second Edition. J. Wiley and Sons, Inc.