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Visual cohort baby recording based on internet of things for maternal and child health service

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Abstract. Maternal and Child Health Service is a health service that makes it easier for the public to monitor the growth and development of infants and toddlers. The people who get this health service are infants less than one year old and toddlers aged 1 to 5 years. Maternal and Child Health Service in the community, especially in rural areas, the medical equipment used is still inadequate, for example to weigh infants and toddlers, maternal and child health official use scales commonly used to weigh rice. Periodically babies and toddlers are weighed by medical personnel, and the results are then recorded in the maternal and child book. In some cases, the registration process is still not efficient, because the possibility of the book being lost. The aim of this research is to design and develop a Posyandu Information System Application as an early warning system for Maternal and Child Health. In this research, first coding from four sensors used are heart rate sensor, weight sensor, temperature sensor and ultrasonic sensor. In the microcontroller, the Artificial Neural Network artificial intelligence method is embedded to learn from inputs to classify decisions / action information from the sensor medical record results. Medical record data and learning outcomes from Artificial Neural Network (ANN) Algorithm will be sent using Internet of Things modules on the server so that they can be accessed by the application server both web and mobile. Visualization of medical record data and the results of the health conditions of infants and toddlers recapitulated on the cohort book periodically and form of cohort graphical report. With the early warning system in the form of a Posyandu Information System Application it is expected that pregnant women or toddlers who have health problems can immediately obtain information as early as possible.

1. Introduction

The degree of public health is assessed by using several indicators that reflect the conditions of mortality (death), nutritional status and morbidity (pain). In this section, the degree of public health in Sidoarjo Regency is illustrated through the Mortality Rate; consisting of Maternal Mortality Rate (MMR), Infant Mortality Rate (IMR), and Under-five Mortality Rate (AKABA), Human Development Index including life expectancy, Morbidity Rate; morbidity rates for some toddlers and adult diseases. Apart from being influenced by health factors such as health services and the availability of health resources, the degree of public health is also influenced by other factors such as economic factors, education, social environment, and other factors [1]. In Sidoarjo Regency in 2017 the infant mortality rate (IMR) of 5.45

per 1,000 live births is lower than the target of <12 per 1,000 live births. But it experienced an increase from the incidence in 2016 of 4.26 per 1,000 live births. The increase in infant mortality due to the condition of the baby beginning with maternal care during pregnancy is not optimal is also possible because of the risk / complications of the mother which causes the baby to be born in a risky condition and makes the opportunity to die. In addition, after-birth care is not optimal because these periods are vulnerable to the baby's period, both intake, environment and knowledge. The proportion of infant mortality is mainly based on time, 68.18% of the most deaths are in the neonatal period. This is because the neonate is a vulnerable period for endurance. Low birth weight (less than 2500 grams) is one of the main factors that contributes to perinatal and neonatal deaths. This situation occurs because several possibilities include maternal and fetal factors themselves, which ultimately inhibits the growth of conception and / or stimulates the occurrence of premature labour. The under-five mortality rate in Sidoarjo Regency in 2017 was 7 per 1000 live births, increasing from the realization in 2016 of 5.39 per 1000 live births. The maternal mortality rate in Sidoarjo district in 2017 amounted to 82.62 per 100,000 live births lower than the target of <87 per 100,000 live births. The maternal mortality rate (MMR) has increased compared to 2016, which amounted to 66.34 per 100,000 live births.

Community-based Health Efforts (UKBM) are a health effort that is managed and organized from, by and with the community, to empower the community and provide convenience to the community in obtaining basic health services [2]. Posyandu (Integrated Service Post) is one form of Community-based Health Efforts carried out by, from, and with the community, to empower and provide facilities to the community to obtain health services for mothers, infants and toddlers [3]. Posyandu are grouped into 4 levels, namely Pratama (Grade 4), Madya (Grade 3), Purnama (Grade 2), and Mandiri (Grade 1) based on institutional assessment, buildings, facilities and infrastructure, cadres, funding sources and excellent programs [4], and the distribution Posyandu in Sidoarjo district shown in table 1. An active Posyandu is a Posyandu that conducts open day activities with a frequency of ≥ 8 times per year, on average the number of cadres on duty ≥ 5 people, the main coverage (KIA, Nutrition KB and immunization ≥ 50%) and there are additional programs and JPKM coverage ≥ 50%.

All community members need basic health services available at Integrated Service Post especially, infants and toddlers, pregnant women, postpartum mothers and nursing mothers, fertile couples, child caregivers [5]. The Government through the Integrated Service Post program seeks to become a means for parents to monitor the growth and development of children from the womb until the age of 5 years. Child health needs to be considered starting in the womb, until finishing childhood, especially until the age of 5 (toddlers). This period until children enter school age is called the golden period, which occurs only once and does not happen again. At this age the character's foundation and children's health are shaped by the parenting style and consumption patterns given by their parents. The growth and development of children at this age is very important for parents. Monitoring the growth and development of children should be the obligation of parents for their children. Through the full support of both parents, it is hoped that the growth and development of children can run optimally so that they will become qualified future generations who will ultimately improve the quality of human resources in the future. Integrated Service Post provides growth monitoring services for toddlers both physically and spiritually, such as measurements of body weight and height.

By conducting routine and periodic monitoring, it can be seen how the process of growth and development of children is normal or not, so that steps can be taken to be done immediately [6]. Based on the problem analysis in the field, the Posyandu recording and reporting process is still manual so that the cadres and Puskesmas (Centre of Citizen Health) officers have difficulty in analysing the data.

Table 1. Distribution of number and cluster of Posyandu in Sidoarjo district.

Year	Total	Pratama	Madya	Purnama	Mandiri
2015	1779	2.36%	18.04%	74.09%	5.51%
2016	1793	1.12%	16.6%	77.9%	4.77%
2017	1476	0.78 %	16.81%	78.67 %	3.74 %

Difficulties in analysing data can have an impact on providing information to pregnant women or toddlers who have obstructed and slow health problems. In addition, data on Posyandu that are not properly recorded will affect the recording and reporting of health workers in determining further policies, especially in relation to the program to improve the quality of maternal and child health [7]. Moreover the opportunity to increase the awareness of pregnant women about antenatal health problems and childbirth and the importance of giving health facilities is overlooked due to lack of health promotion at the Posyandu [8]. In order to improve the quality of services, recapitulation of data on infants, toddlers and pregnant women as well as analysis of the results of routine visits, an early warning posyandu system was developed. The early warning Posyandu system was developed with several features consisting of manual and automatic input processes, medical and non-medical data recapitulation processes, and visualization of visit data based on location and time domain. The data recording process is based on two input components, namely the input made by the officer and the input made by the sensor, the sensor is used to automatically record basic medical data from infants, toddlers and pregnant women [9]. Basic medical sensors and recapitulation data on the results of visits are used as input in machine learning to analyse data patterns [10]. The data pattern will be a learning model of machine learning with artificial neural network algorithms in order to form output variables and predictive material expected condition [11]. The system was developed integrated between the web, the Internet of things and Machine learning to form a more interactive framework in terms of processing, transfer and presentation of data [12]. Prediction results and visit data patterns will form a graph visualization report used by officers to take policy.

2. Method

Records and reporting in this study refer to the Posyandu Information System covering records of pregnant women, births, infant deaths, maternal mortality, childbirth, childbirth, records of infants and toddlers in the Posyandu working area. The Posyandu Information System as an early warning system for Maternal and Child Health records of pregnant women, births, infant deaths, maternal mortality, childbirth, childbirth, records of infants and toddlers in the Posyandu working area, making the data into information resources and visualizing it through cohort form or priority visual graphic form as shown in figure 1. First process start from system requirement and problem analysis from existing system in Posyandu. Second process is done by generating the database and deploying the system framework for Data and Information Analysis in the Integrated Service Post [13]. Databases from the results of medical records can be valuable information material from health information systems, especially for information and policy analysis [14].
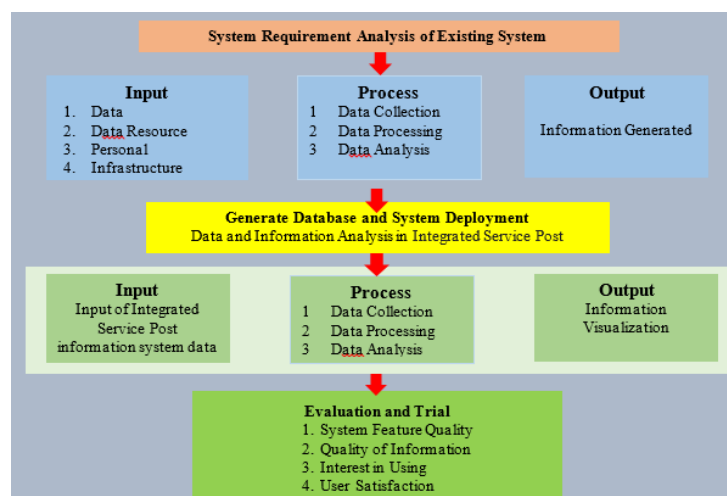

Figure 1. System requirement and development process.

In the input process, an Internet of thing-based automated data recording system was developed using basic medical record sensors such as temperature, body weight and heart rate [12]. Multiple sensor of basic medical sensor will be generated as input for learning model of Artificial Neural Network [15]. The results of the input process are analysed by analysing the rules and Artificial Neural Network algorithms to form data patterns [16]. The data pattern is visualized based on data characteristics to be cohort report and data frequency to obtain information for paramedics. The information was compiled as material for policy making and evaluation.

3. Results and discussion

The early warning Posyandu system collects medical data and non-medical data such as pregnant women, births, infant deaths, maternal mortality, childbirth, childbirth, records of infants and toddlers obtained by Posyandu officers and then visualizes the results of the data analysis process.
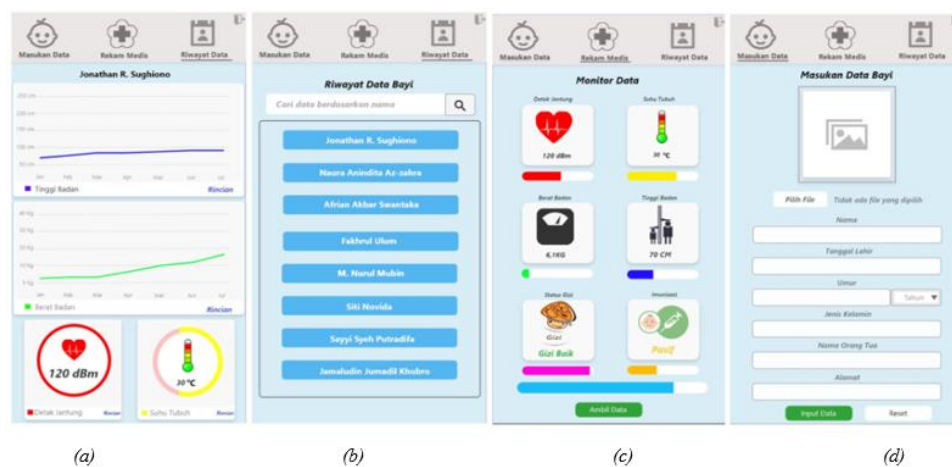

Figure 2. System Application Features: (a) Frequent medical Report progress, (b) List of Baby and Toddler, (c) Baby Medical Report (d) Baby and Child Basic Data Input.

The collected data is processed based on the characteristics and the pattern is formed through the ANN algorithm to record visual forms. Research activities include existing system analysis, identification of system requirements, application design, trial process, and evaluation. The results of implementation and deploy systems are shown in figure 2 that consist of several features including, basic medical data records, frequency of visit data based on the identities of infants and toddlers.

Results of Posyandu early warning system based on figure 2.a shown the cohort graphic of periodical medic and nonmedical report of baby. Every mom and maternal woman who has member of Posyandu can explore and get periodical of her baby medic and nonmedical report by her smartphone. With the early warning system in the form of a Posyandu Information System Application it is expected that pregnant women or toddlers who have health problems can immediately obtain information as early as possible. Figure 2.b shown the report of all member of baby, toddler and maternal woman in every Posyandu. Figure 2.c shown basic medical examination report from each Posyandu member during each inspection visit at the Posyandu. Each new Posyandu member can register as a member to get regular posyandu services to posyandu cadres so that they can be inputted into the early warning posyandu database system as shown in the figure 2.b.

4. Conclusion

The role of Posyandu is very important in improving the quality of Maternal and Child Health, but the analysis of problems in the field shows that the process of recording and reporting of Posyandu is still manual so that cadres and Puskesmas officers have difficulty in analysing the data. Difficulties in analysing data can have an impact on providing information to pregnant women or toddlers who have

obstructed and slow health problems. Therefore, making the Posyandu Information System application as an early warning system for Mother and Child Health is very much needed. The aim of this research is to design a Posyandu Information System Application as an early warning system for Maternal and Child Health. Research activities include existing system analysis, identification of system requirements, application design, trial process, and evaluation. With the early warning system features in the form of a Posyandu Information System Application it is expected that pregnant women or toddlers who have health problems can immediately obtain information as early as possible.

Acknowledgement

References

[1]   Sidoarjo DKK 2017 *Profil Kesehatan Kabupaten Sidoarjo Tahun 2017* 264
[2]   Timur DKPJ 2017 *Profil kesehatan Provinsi Jawa Timur* (Surabaya) 194
[3]   RI KK 2011 *Pedoman Umum Pengelolaan posyandu* 76
[4]   Postovsky V A 1975 On Paradoxes in Foreign Language Teaching *Mod Lang J.* **59** 1-2 18–21
[5]   Maya D N and Ima H U H N U 2015 The Cadre of Integrated Health Service Post (Posyandu) as agent in the Socialization of Cervical Cancer Prevention in Malang Regency, Indonesia : A Cultural Approach *2nd Global Conference on Bussine and Social Science* 681–687
[6]   Zhang Q 2018 Informatics in Medicine Unlocked Web-based medical data visualization and information sharing towards application in distributed diagnosis *Informatics Med Unlocked* 1–13
[7]   Chen Q 2019 Toward realizing self-protecting healthcare information systems : Design and security challenges *Advances in Computers. Elsevier Inc.* 1-37
[8]   Limato R, Ahmed R, Magdalena A, Nasir S and Kotvojs F 2018 Use of most signi fi cant change (MSC) technique to evaluate health promotion training of maternal community health workers in Cianjur district, Indonesia *Eval Program Plann* **66** 102–110
[9]   La H J 2015 A conceptual framework for trajectory-based medical analytics with IoT contexts *J Comput Syst Sci*
[10]   Kononenko I 2001 *Machine learning for medical diagnosis : history , state of the art and perspective* **23**
[11]   Benyelloul K, Seddik L, Bouhadda Y, Bououdina M, Fenineche N and Aourag H 2016 A datamining approach to predict the formation enthalpy for rare-earth dihydrides REH2 (RE = Ce,Pr,Dy) *Int J Hydrogen Energy* **41** 26 11254–11263
[12]   Katole B, Sivapala M and Suresh V 2013 Principle Elements and Framework of Internet of Things *Int J Eng Sci.* **3** 5 24–29
[13]   Rosyid H, Sutaji D and Dijaya R 2017 Sistem Informasi Eksekutif Menggunakan Teknologi Web Service (Studi Kasus Koperasi Warga Semen Gresik) *Seminar Nasional Inovasi Teknologi UNP KEDIRI* 385–390
[14]   Makanga P T, Schuurman N, Dadelszen P Von and Firoz T 2016 International Journal of Gynecology and Obstetrics REVIEW ARTICLE A scoping review of geographic information systems in maternal health *Int J Gynecol Obstet* **134** 1 13–17
[15]   Pannu A 2008 Artificial Intelligence and its Application in Different Areas *Certif Int J Eng Innov Technol.* **9001** 10 2277–3754
[16]   Wang Y, Huang Y, Zheng W, Zhou Z, Liu D and Lu M 2017 Combining convolutional neural network and self-adaptive algorithm to defeat synthetic multi-digit text-based CAPTCHA *Proc IEEE Int Conf Ind Technol.* 980–985