Application of Data Mining for Young Children Education Using Emotion Information

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ABSTRACT
The current preschool education is still facing many difficulties. First, unlike primary and secondary schools which have test scores, there are few good ways to assess the learning situation of young children. Second, it is hard for teachers and parents to give thoughtful care all the time to each child. In particular, recent incidents of child abuse have been exposed frequently, causing social panic. However, as research of young children's mental health and emotion is still in its infancy due to the lack of relevant data, methods that focus on measuring and analyzing young children's mental health and emotional states are lacking. Furthermore, on the one hand, the principal goal of preschool education is to stimulate interest and enhance cognitive ability. On the other hand, assimilation and accommodation which are two specific stages of cognitive development require an active learner, not a passive one. Thus, emotion analysis can solve these problems to some extent.

In this paper, we design an intelligent system, obtaining video clips in a kindergarten's classroom and managing to leverage the emotion data to portray cognitive learning rules and mental states of young children. At the same time, with the augmentation by data analysis, it brings broader applications developing educational policy and teaching practice. For example, children with abnormal behaviors such as violent mood swings and unusual time nodes during courses can be detected and notified to parents and teachers. And it is meaningful to measure the children's acceptance and preference of course activities and content which has been explained in our experiments.

DSIT2018, July 20–22, 2018, Singapore, Singapore

ACM ISBN 978-1-4503-6521-5/18/07…$15.00
https://doi.org/10.1145/3239283.3239321

CCS Concepts
• Computing methodologies→ Cluster analysis • Computing methodologies→ Supervised learning by classification • Computer systems organization→ Real-time systems

Keywords
Emotion analysis; data mining; young children education.

1. INTRODUCTION
In the era of data, education is closely linked to big data and artificial intelligence, from early childhood to higher education. Promoting the comprehensive integration of information technology and education is the mainstream trend of school which is aimed at the key issues of analysis and application about education. However, many of the past studies were based on online courses, particular web-based courses, and well-known learning content management systems [1]. But for offline classrooms, there is very little research especially for young children.

Gathering rich educational big data is not that hard due to the advancement of hardware equipment and networks. But most processes focus more on feedbacks about study [1], neglecting social and emotional development, the crucial aspect which is worthy of educators' and parents' attention. Because emotion can reflect physical and mental state, which will influence study achievement and growing health. How educators and parents respond to children's emotion will affect children's education in ways that affect their social, emotional, and cognitive state [2]. In particular， a research on programs focused on social and

emotional learning shows that a systematic process for concentrating and promoting students' social and emotional development is the common element among schools which have an increase in academic success and get improved quality of relationships between teachers and students, and a decrease in problem behavior of students [3].

Rationally, the use of emotional recognition is typically conducted in service of education and intervention of young children. Meanwhile, data analysis and modeling can efficiently help achieve scientific education management and individual service, for example, providing important indicator of educational evaluation.

1.1 Character Building

There is growing recognition around the world that education must meet the social and emotional needs for students which contribute to effective teaching and learning, furthermore reaching students' full potential in their whole life. Nobel Laureate, James Heckman, believe that the greatest feedback on education investments are "from nurturing children's non-cognitive skills, giving them social, emotional and behavioral benefits that lead to success later in life…" [2].

Moreover, many educators have confirmed that early childhood education, especially from 3 to 6 years old, plays a critical role in character building which influence the way people respond to environment and society, and furthermore decide whether they can succeed in study and career in their later life to some extent. The children's 85% -90% character and lifestyle are formed during this period. Ages 2 through 7, during this stage, children develop memory and imagination. They are also able to understand things symbolically, and to understand the ideas of past and future [4]. If children show some traits in this period, parents need to give necessary intervention and help. Such as performance of over-excited, for example, it is difficult for extroverted child to sit still, keep calm or focus attention. On the contrary, some children hate to participate in group activities, look inactive and usually silent, and lack independent ability. These are the performance of introverted type. Thus, parents should give correct intervention, such as consciously creating a lively and happy atmosphere in the family, taking the initiative to talk with their children and ask some kinds of interesting questions, as well as accompany children to outdoor sports and other interesting activities to shape the child's character.

Overall, in the "golden" three years for child's personality correction, only if parents understand the child's psychological characteristics, knowing the child's temperament, can they promote parent-child relationship, find the proper direction of education. In other words, only knowing children and understanding their potential advantages indeed, can help parents give rationally love and cultivation.

1. 3 Psychological Health

Studies show that more than 30 million adolescents are in sub-health status. And suicide has become the biggest cause of death among Chinese adolescents. In particular, psychologists have shown that these are related to the individual character and growth experience. In addition, they also show that Chinese families generally lack in-depth contact with their children and lack due attention to their emotions [5].

Furthermore, it is reported that child abuse and school bullying have occurred more and more frequently, destroying children's young heart and cause panic among parents. However, children's ability to describe and understand what have happened is limited, it is difficult for parents to detect the strange condition of child. Considering the relationship of emotional condition and daily life experience, our system has the potential to help analyze incidents such as child abuse and school bullying. Since our intelligent system can help catch and analyze abnormal situation for discovering and solving problems in time, it will be easier to protect children from hurt. For instance, if a child shows persistent or extremely negative emotions, it is rational for us to pay attention to what he/she has suffered, so much as deeper reasons such as character flaw.

Through sentimental data analysis and statistics, we can find children manifested a marked tendency toward disturbance of mood and affect or detect some unusual time nodes which may indicate abnormal conditions. The understanding of sentimental conditions of children might provides the potential for teachers to focus on the condition of such children. As for parents, child showed an abnormal state of data analysis might help them pay special attention in time since it is highly possible that the child has been meeting some problem or suffering misfortune in his/her recent study life. Thus, the introduction of sentiment analysis seems to have met the goal of better care about psychological health.

1.4 Child Cognitive Rules

The learning cognitive development and psychological characteristics of kindergarten children have apparent features [6].

For example, kindergarten children in lower grades love imitation, as well as driven by intuitive thinking. The ability of young children to regulate and control their behavior is weak and to a large extent still subject to external stimuli and situation constraints [6]. Thus, their expressions and behaviors may be directly influenced by the course, teacher or classmates in a short time period. Therefore, monitoring the class images and capturing emotional information are useful, since they largely reflect the surrounding environment. In addition, children in kindergarten love things to be the most changeful. That means negative expressions such as disgust, contempt might suggest tedium of the course, which will inspire educators to think about the course arrangement.

2. COGNITIVE INTELLIGENCE SYSTEM

2.1 System Architecture

The goal of our young children education intelligence system is to use intelligent technology to identify children's information, including child identity, time nodes and emotion information in order to provide data for subsequent research. In recent years, cognitive intelligence technology has been gradually applied in commercial environment, such as face scan payment. In particular, as for applications for young children education, it requires emotional information in order to better analyze young children who are lack of the ability of expression, face and emotion recognition become the basic technology of this system.

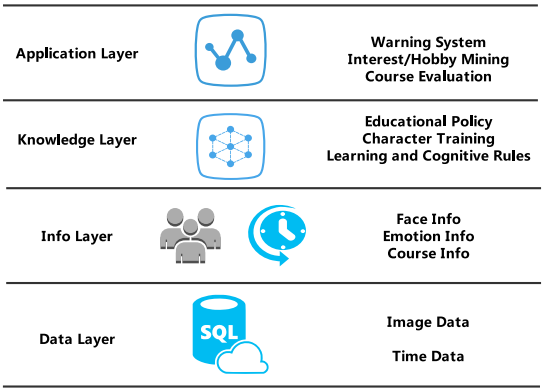

Figure 1. Knowledge structure of the system.

To meet the requirements mentioned in section 1, our intelligent cognitive system have been designed. The architecture of the cognitive intelligence system is shown in figure 1.

Individual statistics: particular equipment is mounted to collect video information and in data layer they will be convert into images for the convenience to be processed by subsequent algorithm. In info layer, the system can accurately count the number of children through face detection and recognition technology. Then unique id number will be given to each person. At the same time, the accurate authentication of face information also helps to record and analyze the emotional and behavioral information of the same child at different time and courses.

Feature recognition: Intelligent analysis systems need the ability to recognize individual feature. Through cognitive intelligence technology, we can identify and record each child's facial information. Combined with the actual environmental information, including date information, time information, we will sort out many complete timelines to analyze the learning and sentimental conditions of young children.

Emotional analysis: Through sentiment analysis technology, the system can identify and record the emotional information of each face at any time which is helpful to analyze the child's mental condition and sentimental changes which might reflect not only their preference of course, but also their condition of psychological health. Specifically, there are seven emotions including happy, sad, angry, surprise, disgust, neutral, disgusted and more detailed information has been given in section 3.

Since sentimental information has been obtained for each child, it will provide many corresponding application services for parents and educators, including reminders of violent mood swings, learning quality evaluation as well as psychological health monitor.

To enable our goals to obtain and analyze sentimental information, the overall process of intelligent cognitive system has shown in figure 2. First of all, the captured image is subjected to face detection in order to determine human faces in the image as well as the specific regions. Then compare each detected face to faces in the database in order to determine whether it has been existed. We call the module uniqueness test used to count accurate number of children and avoiding redundant computing. Next, a new id will be distributed to a new face, or just new information will be added to existing ids.

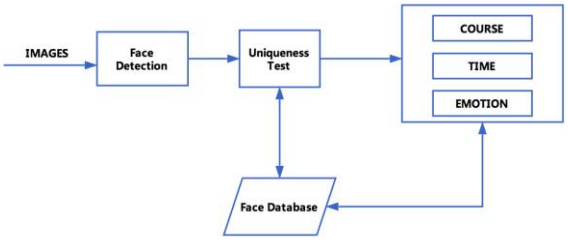

Figure 2. Process flow for cognitive intelligence system.

2.2 System Design

To realize the architecture mentioned above, specific hardware equipment and algorithm support are required. The overall system design is shown in figure 3. Definitely, we need particular camera to collect video information in kindergarten classes. Then face information and time data can be obtained through cloud database and data processes. Secondly, through face detection and recognition, sentimental information will be extracted and processed by deeper data mining for more individual characteristics. Finally, the analysis results will be clearly showed through visual reports. Next the detailed process will be given.

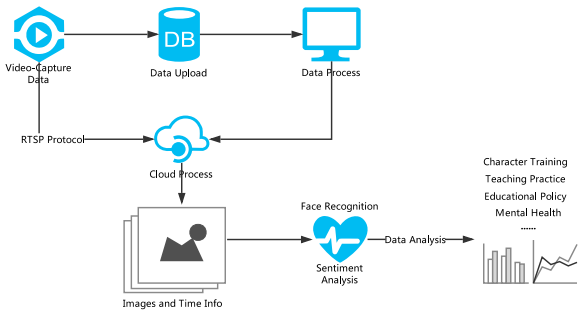

Figure 3. System architecture.

2.2.1 Data Collection

Hikvision smart camera is specially used for data acquisition. The maximum resolution of this camera is up to 4M pixels, and 30fps real-time image can be output at this resolution. And the function of fog penetration and electronic image stabilization are supported. In addition, the deployment of the camera is as far as possible to avoid low light scenes, backlight scenes and other issues. Hence it can be well applied to the acquisition of image and video resources. In particular, we have re-developed the SDK provided by Hikvision Camera to enable it to take pictures or record videos whenever it's needed.

2.2.2 Data Transmission

In this network environment that supports RTSP streaming media data transfer, we use FFMPEG on the server side to process the video stream so that it provides a clear picture of the moment as we need. In the use of FFMPEG for image acquisition, multi-threaded processing solutions for each image to open up a separate thread successfully solve the time delay problems in a particular situation where a large number of cameras work at the same time. Then, the image will be uploaded to Azure block storage after acquired. In addition, between the get and upload process, there is a Redis-based buffer so that these two modules

are decoupled and asynchronous processing to support larger concurrency can be realized.

In particular, secondary development of the SDK provided by the Hikvision camera is adopted in the image resource acquisition module. The script periodically sends a request to the server, calls the corresponding executable file for image acquisition according to the rules. Then upload information to the cloud.

2.2.3 Emotion Analysis

After getting image sets, emotional recognition for every faces in collected images will be done following face detection and recognition through the Microsoft's interface for face and emotion recognition.

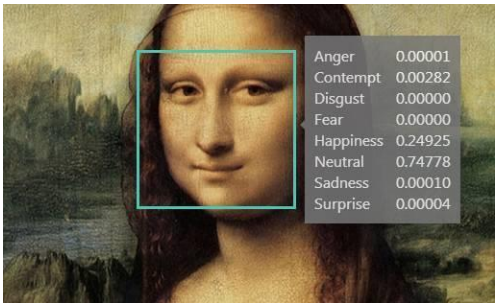

Image 1. Example of emotion recognition.

Emotion Recognition API adopts the facial expression in the picture as an input, which is shown for each face in the picture, and also marks the face range with the face recognition API. If the user has already called the face recognition API, the face box can also be submitted as an optional entry. Detectable emotions are anger, contempt, disgust, fear, happiness, expressionlessness, sadness and surprise. These emotions have specific facial expressions and are thought to be intercultural and universal [7].

As is shown in image 1, when interpreting the results obtained by the API, the highest-rated facial expression should be the result, with the scores normalized. To meet the demand, developers can set higher confidence thresholds.

3. EXPERIMENTS

To support our experiment, we obtained image information of 4 different classes in a kindergarten by mounting smart cameras in classrooms. During each 30-minute class, the cameras captured children's facial expressions every 10 seconds. And in order to analyze individual features, the first step is to recognize faces among different children and give each child an id. Then the emotion of each face from images will be recognized. These data then made up the features for data mining.

Particularly, out of the protection of the children's privacy, all the pictures related to the classroom were made with mosaics on the child's face.

3.1 Datasets

This dataset is based on the collection of images of 4 classes in a kindergarten with emotion recognition for each face in each image, a total of 14,049 sets of data, including 38 children with different IDs, covering 7 different expressions: ANGER, CONTEMPT, DISGUST, SADNESS, HAPPINESS, NEUTRAL and SURPRISE. According to the records of time nodes, there are 4 different courses, each lasting 30 minutes. As is shown in table 1, the NEUTRAL emotion takes up over 90% of all emotions we have collected. Meanwhile HAPPINESS, SADNESS and SURPRISE occupied a rational percentage. However, ANGER, CONTEMPT and DISGUST are rarely caught.

Table 1. Overview of emotion statistics

EMOTION	COUNT
ANGER	13
CONTEMPT	4
DISGUST	2
HAPPINESS	734
NEUTRAL	12934
SADNESS	106
SURPRISE	256

Especially, these seven types of emotions are divided into three major categories: positive, negative, and neutral. A large part of our experiment are based on these three categories for certain reasons. Firstly, as mentioned earlier, the emotions of different categories in the data set are not balanced. In order to alleviate the problems caused by the data imbalance, we combine small categories into large ones. Secondly, our experiments more often describe children's emotional changes from a macro perspective. Specifically, we are more concerned about whether children's emotions are positive or negative. This is more in line with the original intention of the system design, which is to detect the children's emotional fluctuations, and to judge the quality of the entire classroom through the positive and negative proportion of emotions. These goals do not require us to carefully study the subdivided expression categories.

Meanwhile, there is a tough situation, as we know, where SURPRISE is a complex emotion which always have different meanings with much ambiguity, since people can express surprise both in happy and threatening situation and it is difficult to recognize whether it is a pleasantly surprise or a frightened surprise. While, after many sample observations, we have found that HAPPINESS emotions are usually dominant in the case of appearing SURPRISE and therefore can be SURPRISE directly divided into the same category with HAPPINESS. Hence, we define ANGER, CONTEMPT, DISGUST, and SADNESS as negative emotions. Meanwhile HAPPINESS and SURPRISE are positive ones. And NEUTRAL belongs to neutral category naturally.

In order to more clearly demonstrate the emotional patterns of children in the classroom, we use counts of the seven emotions during a specific time period as a child's seven features, manipulate them by clustering. For example, feature vector [357, 54, 13, 15, 2, 0, 6] means, during a class, the number of times that the child was detected to have a neutral emotion was 357, and 54 for happiness and so on. Definitely, data preprocessing has been done including normalization, which is done to not have a group of features influence the clustering just because these features have higher values than the other. Specifically, the k-means algorithm is used in the clustering.

3.2 Course Analysis

According to the definition above, next we will analyze 3 of these distinct classes from multiple perspectives to evaluate the sentimental states of children.

3.2.1 Course 1

Course1 lasted for 30 minutes, from 15:30 to 15:59. Table 2 below shows the proportion of all emotions occurred in the course. Positive emotion takes up about 5.4%, dramatically higher than

that of negative emotions (0.78%). These relatively small proportions are explainable because neutral emotion occupied too large.

Table 2. The proportion of each emotion in course 1

emotion	
surprise	1.35%
happiness	4.04%
neutral	93.85%
anger	0.10%
sadness	0.63%
disgust	0.05%

count: 1 – 1,952

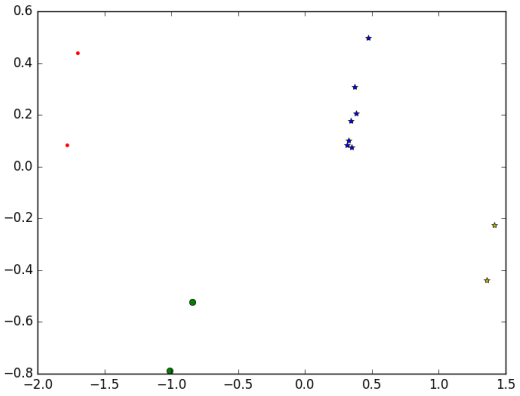

Figure 4. The clustering result of class 1.

First, we use Min-Max Scaling to normalize data. After clustering by K-means algorithm with k=4, we do the principal component analysis to identify how well the result will be demonstrated in a 2-dimensional space. The principal component analysis screened out the first principal components, whose cumulative variance proportion was 83.52%, which means a reliable result.

According to figure 4, the blue stars make up the largest cluster. Meanwhile, there are some outliers which is particularly worth our attention. No.48 and No.51 children in table 3, corresponding to two yellow stars in figure 4, have the same characteristic that the relative count of sadness is dramatically larger than other children's. These two children, occupied 13% of all children, showed more negative emotions. And figure 5 below shows the emotional changes of the two children over the whole class by Gantt charts.

Table 3. Each child in course 1 with 7 features and labels after clustering, features are normalized

ID	neutral	happiness	surprise	sadness	anger	disgust	contempt	label
43	0	0.235294	0.2	0	0	0	0	0
41	0.431373	1	0	0.25	0	0	0	0
52	0.372549	0.117647	0	0	1	0	0	1
44	0.647059	1	0	0	1	0	0	1
46	0.784314	0	0.2	0	0	0	0	2
38	1	0	0.2	0	0	0	0	2
39	0.882353	0.176471	0.1	0	0	0	0	2
50	0.941176	0	1	0.25	0	0	0	2
40	0.862745	0.117647	0.1	0	0	0	0	2
42	0.647059	0.055882	0.2	0.25	0	0	0	2
49	0.901961	0.058824	0.5	0	0	0	0	2
48	0.882353	0	0.2	0.75	0	0	0	3
51	0.431373	0	0	1	0	0	0	3

Figure 5. Two children showed more negative emotions, here is their emotional changes over time.

It can be seen in figure 5 that negative emotions appeared in the first half of the class and both children showed positive emotions in the latter half of the course. After actually observing the video of class 1, we found that in the first half of the class all the children sat and listened to the lesson. As is shown in image 2, many children have become inattentive or even sleepy. However, in the second half, everyone stood up and participated in an activity (image 3). It obviously infers that young children prefer interactive teaching method.

Image 2. The first half of class 1.

Image 3. The second half of class 1.

3.2.3 Course 2

Table 4. The proportion of each emotion in course 2

emotion	
surprise	1.40%
happiness	6.72%
neutral	91.11%
anger	0.07%
sadness	0.70%

count: 1 – 1,302

Course 2 also lasted for 30 minutes, from 15:30 to 15:59. Table 3 shows the proportion of all emotions occurred in the course. Particularly, positive emotion takes up about 8.1%, 2.7% larger than course 1 and 2% larger than course 3 shown in table 4. So it may imply this class is more active and more appealing to children.

Similarly, Min-Max Scaling is used for normalization as well as K-means algorithm for cluster with k=4, we also do the principal component analysis to give a visual representation in a 2-dimensional space. The principal component analysis screened out the first principal components, whose cumulative variance proportion is over 82%, which means the result in 2-D space is reliable shown in figure 6.

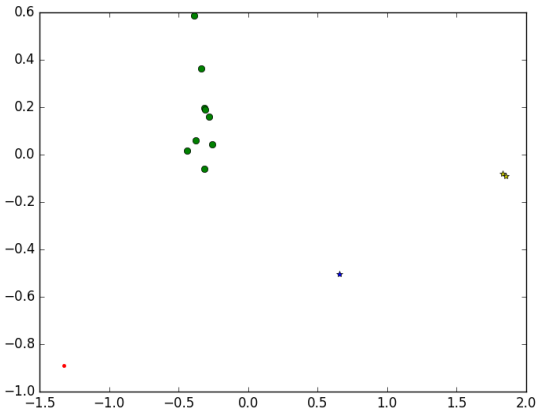

Figure 6. The clustering result of class 2.

Comparing the clustering result in figure 6 and normalized data in table 5, the cluster consisted of green dots represent children who is relatively positive during the course. However, we are more interested in 4 outliers shown in figure 6 which may infer some abnormal situation or just noise. In detail, there are totally 13 children in class 2, however two of the 13 data sets are found to be noise, since when tracing the two yellow stars to raw feature data we find out they cause huge variance. Next, the blue star, corresponding to No.45 in table 5, represents a child who had been detected the most sadness of all other children but few happiness. Moreover, No.41 in table 5, corresponding to the red dot, represents a child who is sad, even anger but also happy during a course. It rationally represents a dramatic swing of mood which is worthy of paying attention.

Table 5. Each child in course 2 (represented by ID) with 7 features and labels after clustering, features are normalized

ID	neutral	happiness	surprise	sadness	anger	disgust	contempt	label
41	0.616438	0.5	0	0.4	1	0	0	0
43	0.643836	0.666667	0.6	0.4	0	0	0	1
38	0.979452	0.041667	0.6	0	0	0	0	1
47	0.979452	0.375	0	0	0	0	0	1
48	0.691781	0.291667	0.2	0	0	0	0	1
46	0.835616	0.25	0.4	0	0	0	0	1
50	0.760274	1	0.4	0.2	0	0	0	1
51	0.80137	0.25	0.4	0	0	0	0	1
42	0.808219	0.208333	1	0	0	0	0	1
52	0.623288	0.333333	0.4	0	0	0	0	1
45	1	0.083333	0	1	0	0	0	2

Figure 7 shows emotions over time of the child corresponding to the blue star in figure 6. It is shown that this child is happy just like other children in the first half of the course, but by 3:37 until the end of class, this child had often shown sadness. The reason is, traced back to the original pictures (image 4), at 15:37, the teacher tried to stop the child marked in red rectangle and a girl from standing up. Since then, the boy did not have a happy expression until the end of the course (image 5).

Image 4. The clip of video at 15:37:42pm, the child marked in red rectangle is the No.45 corresponding to the blue star in figure 6.

Image 5. The clip of video at 15:38:52pm, the child marked in red rectangle is the No.45 corresponding to the blue star in figure 6.

Figure 7. No.45 child showed more negative emotions, here is his emotional changes over time.

3.2.4 Course 3

Course 3 also lasted for 30 minutes, from 15:30 to 15:59. Table 6 below shows the proportion of all emotions occurred in the course. Positive emotion takes up about 6.1%.

However negative emotion occupies 0.95%, larger than other courses. This is an interesting situation. As we found, the proportion of negative emotions detected in this lesson was higher than the other two classes. Tracing back to original image sets, we found that the biggest difference between them was that in the other two courses, children had been arranged to stand up and participate in some interactive games. It might reflect that young children prefer to stand up and learn in an interactive way to some extent.

Image 6. A clip of course 3 when children taking papers and pens to participate in the course.

Furthermore, there is another interesting situation where the counts of sadness detected in the first ten minutes (15:30-15:40) is considerably more than that in the second (15:40-15:50) and third ten minutes (15:50-15:59), even more than the total sum of the second and third ones. In detail, the number of sadness detected in the first ten minutes is 45. However, the total sum of twenty minutes (15:40-15:59) is 33. When observing the course clips, it is shown that in 15:30-15:40, children sat and just listen to the lesson. But in 15:40-15:59, they were taking papers and the pens to participate in the course (image 6). It might be another signal to prove that children prefer an interactive way to learn. These two phenomena meet the conclusion of Piaget's theory that children learn best through doing and actively exploring [8]. It is similar to Responsive Classroom (RC) Approach, a set of teaching practices that integrate social and academic learning, reported improving academic performance [9]. Furthermore, positive environments will foster safety, care, and mental health [10].

Table 6. The proportion of each emotion in course 3

emotion	
surprise	1.77%
happiness	4.35%
neutral	92.92%
anger	0.09%
sadness	0.81%
contempt	0.04%
disgust	0.01%

count: 1 – 8,482

Min-Max Scaling was used for normalization as well as K-means algorithm for cluster with k=4, the principal component analysis was also used to give a visual figure in a 2-dimensional space shown in figure 8. The principal component analysis screened out the most principal component, whose first dimension variance proportion is 0.82994753, which means the result in a 1-D space is reliable enough.

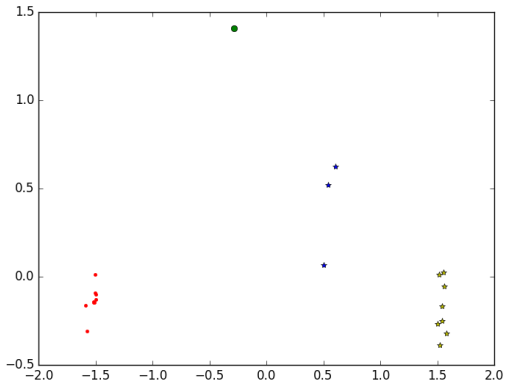

Figure 8. The clustering result of class 3.

There are 21 children in class 3. The cluster shown in figure 8 consisted of yellow stars represents children who had shown more surprises which imply that they are more addicted to the course corresponding to label 3 in table 7. As for children with label 2 in table 7, not only had they shown happiness but also more sadness than others which is a kind of mood swing, corresponding to blue stars in figure 8. For example, the girl with ID 6 showed the most sadness in this course. Tracing back to original image sets, we found something special (image 7) that she might have something wrong with her stomach since she was sad with two hands pressing her stomach.

Image 7. The clip of video at 15:36pm, the girl marked in red rectangle was sad with two hands pressing her stomach.

Furthermore, another child corresponding to the green dot is the most worth paying attention. As is demonstrated in table 7, the child (No.20) has shown happiness, surprise, sadness, anger even contempt in 30 minutes. Obviously it is a dramatic swing of mood. And it is the time our system will record it and alert parents which might provide the potential for parents to guide the child, so that the child's character might be build better which is beneficial to his/her later life.

Table 7. Children corresponding to blue star, green dot and yellow star in course 3 (figure 8) represented by ID with 7 features and labels after clustering, features are normalized

ID	neutral	happiness	surprise	sadness	anger	disgust	contempt	label
20	0.57429	0.941176	0.761905	0.466667	1	0	1	1
30	0.449082	1	0.761905	0.866667	0	0	0	2
6	0.804674	0.323529	0.095238	1	0	0	0	2
25	0.616027	0.955882	0.095238	0.4	0.5	0	0	2
5	0.921536	0	1	0.466667	0	0	0	3
19	0.669449	0.073529	0.761905	0.066667	0.5	0	0.333333	3
28	0.834725	0.441176	0.47619	0.2	0.5	0	0	3
36	0.657763	0.147059	0.619048	0.066667	0.5	0	0	3
34	0.8798	0.088235	0.52381	0.066667	0.5	0	0	3
32	1	0.161765	0.571429	0.2	0	0	0	3
24	0.572621	0.367647	0.333333	0.266667	0.5	0	0	3
31	0.754591	0.411765	0.52381	0	0	0	0	3

Overall, it is normal and common for most children in the classroom to show curiosity and happiness with new things. However, you will always find that there is a small number of children with extreme negative emotions or dramatic swing of mood. These special cases require us to pay attention and give help in time. The benefits of real-time detection and emotion analysis can thus emerge. First of all, for the teachers, they can use this kind of data analysis to observe whether their curriculum arrangement meets the children's cognitive rules and whether the children are willing to accept such education methods. In addition, it can help detect mood swings or passive attitude towards learning, thus parents can give timely intervention and guidance. In the meantime, for parents, the ability to view the child's emotional changes in real time and understand the child's mentality is so much crucial since parents are always too busy to take into account the child's psychological development and emotional conditions, which is precisely the most important aspect for growth of a young child.

According to Piaget, a French psychologist [8], cognitive development was a progressive reorganization of mental processes as a result of biological maturation and environmental experience. Children construct an understanding of the world around them, then experience discrepancies between what they already know and what they discover in their environment [8]. Furthermore, as Piaget's theory, assimilation and accommodation which are two specific stages of cognitive development require an

active learner, not a passive one, because problem-solving skills cannot be taught, they must be discovered [11]. Thus, we need a way to easily reflect the child's preference and response to the course so that we can adjust the teaching mode and course contents. Observing and understanding emotion can actually help according to our experiment.

3.3 Future Work

There are still many deficiencies in our experiments that need to be improved. First we will show a representative example about a special time period and give our idea for promotion.

As is demonstrated in figure 9, in a minute (15:32), many negative emotions were detected in the classroom.

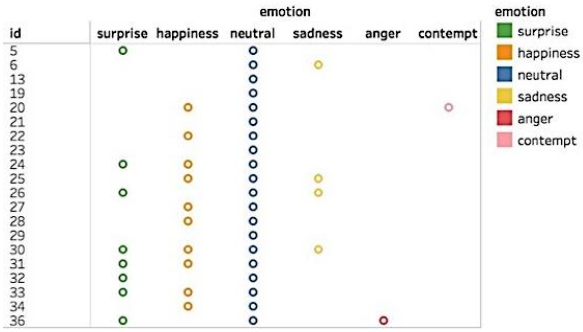

Figure 9. Emotion overview in 03:32 pm, Dec 4, 2017.

It implies that something different had taken place during this period of time, causing violent fluctuations in the mood of many students in this classroom. For better analysis, we traced this moment to the original clip (image 8) which showed a strange sight that many children seemed to be unhappy. Whereas, there is no camera at the back of classroom, it is unable to get specific information about the front of the room, such as the contents of lectures which cause great fluctuations in the mood of the children.

Image 8. Many children in course 3 showed negative emotions in 03:32 pm.

In the future, to promote our experiment, we will mount cameras at the back of the classroom, so that the teachers and course contents can be monitored, making it possible to analyze what happens on the podium during this unusual period of time. This way will provide potential for us to analyze what content may cause discomfort or is difficult to be accepted by children. In addition, it will bring broader applications developing educational policy and teaching practice.

In addition, the precision and reliability of the emotion recognition technology still have a great potential to improve. For example, the ID 20 child in section 3.2.4 who had a dramatic swing of mood even including contempt. However, when tracing it to the original clip we found that the emotion classification was not that reliable. Thus, it requires us to improve the recognition algorithm and architecture to improve the robustness of the entire system.

4. CONCLUSION

Overall, in this era of information explosion, it is worth of collecting useful information and mining valuable phenomena and policy to make data better for young children education.

We have designed an intelligent system, obtaining the collection of clips using real-time cameras in kindergarten's classroom, emotion recognition of image was used to capture the emotional information of young children which is integrated into the student's feature. Then gathering and analyzing these features by data mining methods reached important conclusions, related to young children emotional condition and character training, which is beneficial to develop educational policy and teaching practice [12].

And according to our experiments, it has been proved that our method does reflect many meaningful situations and reach many valuable conclusions, worthy to be considered by educators. For example, children learn best through doing and actively exploring which was seen as central to the transformation of the school curriculum [8] [12]. Furthermore, it will create many applications that are helpful to teachers and parents, such as prompt reminders of children's mood swing and evaluation of children's acceptance and preference for courses and activities, which provide the potential for parents and teachers to be able to pay more careful attention to children's learning and living conditions. All of these will enable more intelligent, interactive and effective education.

5. ACKNOWLEDGMENTS

This work is supported by National Natural Science Foundation of China, 61602048, 61520106007, 61601046.

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