# AN INTELLIGENT ROBOT FOR MONITORING AND PROTECTING TODDLERS

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Project Proposal Report

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## DECLARATION

I declare that this is my own work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

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|---|---|---|
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The above candidate has carried out research for the B.Sc. Dissertation under my supervision.

Signature of the Supervisor: _____      Date: _____20.03.2023_____

# ABSTRACT

Robotics (R), Machine Learning (ML), and Artificial Intelligence (AI) are three of the most popularly used terms in the current era due to the industry of Information Technology (IT) being radically transformed by these technologies (IT). The proposed system has been designed to address the rising safety concerns of cares for young children. With the rise of technology and automation, there is a need for innovative solutions that can provide effective monitoring and protection for toddlers, particularly in situations where direct supervision is not always possible. Robotics, Open CV-related technologies, Machine Learning, and Artificial Intelligence will be incorporated into these solutions. We intend to include features such as; (1) a toddler-proof robot navigation system with obstacle avoidance and safe movement. (2) To establish virtual monitoring of the toddler's surroundings to provide parental oversight and detect unauthorized hazards.(3) Develop system also offers reliable alerts based on child behavior. (4) Develop interactions with robots that are more effective and familiar to toddlers and their activities. Among these parts, the part that I want to develop is a method that informs the parents of the child's behavior according to the behavior of the child that is being looked after by the robot that we are producing. Therefore, an alert system should be created to send a message to the parents based on the child's behavior. With the aid of the aforementioned technologies, I must create an accurate alerting system.

Key Words – R, AI, ML, and IT.

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# 1  INTRODUCTION

The hectic schedules of today's parents pose numerous challenges. Our group identified the need for more time to care for their children as a central issue. The fact that there are still numerous requirements to fulfil remains a significant problem. Failure to meet a child's needs, when necessary, can result in abuse on both sides. As our fourth-year research project, we chose a solution after considering the child and the parent. The solution we provide will enable parents to remotely monitor their child, gain insight into the child's external influences, recognize when the child's behavior requires attention, and play music or communicate with the child. Our group intends to provide four solutions to the primary issue. In this instance, we decided to construct a mobile robot that can assist parents in meeting their children's needs. The robot can move around the child's location. In addition, our team intends to synchronize the robot's movements with the child's behavior and we have decided to develop a method for detecting the child's behavior and alerting the parents.

It was my idea to introduce a successful alerting system through the robot that was designed to be created. That is, a system that gives parents an idea of their child's behavior wherever they are. For example, Informing parents through an alert when the child is about to enter a dangerous area, Detects the child's behavior when he kneels or falls and alerts the parents through an alerting system.This alert system helps parents know about their child, no matter where they are or what they are doing. I believe this will be an effective method for busy parents to care for their child.

## 1.1    Background & Literature Survey

This chapter provides a description of the previous research works that have been carried out in relation to the project that were proposed, as well as the current work status of the project. The following is a summary of the different researchers and projects that have been attempted in the past that are similar to the proposed project.

01) **Research on Child Care Robot and the Influence on Children (Nanjing Tech University, Mechanical Engineering & Automation, Nanjing, Jiangsu, China,210000)**

- As the global industrial structure changes, family units tend to get smaller and more tightly knit. This causes a decline in parental communication and interaction with their children. Consequently, robots for child companions are emerging on the market to meet the demand for accompanying children and providing them with superior protection when their parents are not present. With continuous optimization, upgrade, and refinement of children's intelligent robots, children's robots can assist in meeting the needs of surrounding security monitoring, interactive education, and entertainment. The robots can benefit the development of children and parental care. The rapid growth of internet intelligence products, the continuous development of large data sets, as well as a variety of intelligent technology advancements step by step, children's intelligent robot rapid progress, rapid development in just a few years from the beginning of simple only point-read functions of children's intelligence, machine learning, and development to the current child intelligent AI education robot and various types of high-tech children's robot. The children's robot is transitioning gradually from a single function to a high-tech, intelligent, comprehensive nursing robot.

- There are numerous types of robots for children, but those geared towards child care represent only a small portion of the market. The purpose of the robot for child care is not only to monitor the children's every action, but also to play with lonely children. The robot should provide children with a sense of security and happiness, and raise them in a

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positive environment. Since the design of a robot is not a simple accumulation of functions, we must conduct a detailed analysis of the child-care robot's functions.

- As soon as the two-child policy was lifted, the child-based market became extremely active. With tens of millions of babies born annually, some parents born in the 1980s and 1990s are increasingly willing to invest heavily in their children's development, particularly in education. In addition, as a result of the rapid development of atypical intelligence in recent years, accompanying robots with educational features for children have become a hot project among entrepreneurs, who devote a great deal of effort to the project's research.

- As most Chinese mothers born in the 1980s and 1990s are highly educated, they are more open-minded, independent, and prefer to work outside the home rather than remain housewives.

- However, young parents have less time to spend with their children as a result. Many children must become abandoned children. China has 56 percent of empty-nest families, with nearly 70 million children left behind, according to statistics.

- In the meantime, children with certain health problems often have a lot of trouble with their social and emotional lives. Autism-afflicted children have difficulty maintaining eye contact with humans, but not with robots.

- So, the robot that cares for children has become a close friend to many young parents. Consequently, this type of robot has a vast market waiting to be explored.

*Figure 1*

## 02) ARTIFICIAL INTELLIGENCE FOR HUMAN BEHAVIOR ANALYSIS
### (Divyashree M H1, C.S. Shivaraj2)

- Artificial intelligence in Computer vision is used to learn various methods to analyze, reconstruct, and comprehend three-dimensional images from two-dimensional scenes based on the actual relationship of structures present in a particular video. It consists primarily of techniques for acquiring, analyzing, and processing digital images. Video processing is prevalent in social gatherings, international borders, banks, sports stadiums, workplaces, airports, and shopping centers. In the field of computer vision, human detection, tracking, and activity recognition have gained importance. The identification and tracking of moving objects, as well as the activity recognition of these bodies, is a difficult task for video surveillance systems. Recently, this has been implemented in a variety of artificially intelligent video management and monitoring systems.

- Applications include detecting anomalous behavior, providing security using surveillance video, patient control units, sports video, and traffic management.

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- This is a well-planned and effective way to find events and activities that involve motion in a set of recorded videos. In some circumstances, a greater number of actions may exhibit variations due to degraded video quality, a shifting background, overlapping situations, different human viewpoints, background disturbances, and the presence of numerous entities that are constantly changing. Recognition of Human Being Activity is primarily used for human-to-human interactions because it provides information about people's identities, behaviors, personalities, etc. It is widely used in the interaction between computer robotics and humans, which depicts the behavior of many individuals. All of these require a system that identifies distinct types of activity.

- This is an important technology because it can be used in real-time scenarios. Until now, research has focused on identifying simple human activities such as running, walking, hand waving, etc. The primary objective of designing a HAR system is to automatically analyze existing events and motion and obtain the required context from the captured data.
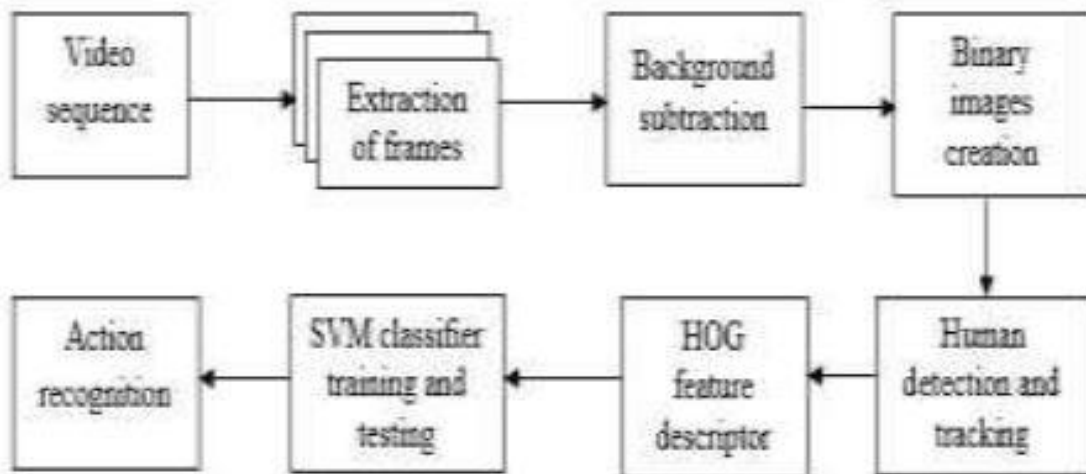


*Figure 2*

- Implementing artificial intelligence for human behavior analysis with "MATLAB". The datasets include human actions such as stand, walk, punch, handshake, hug, kick, and

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fallback. The implementation of the 'HAR' begins with frame extraction. The extraction of frames begins with acquiring information about the video file's size, memory, quality, resolution, etc. using the 'aviinfo' command. Using the "video reader" command, video is read, and then the 'numframes' command generates the number of frames in the video. After obtaining all frames, a loop is executed until the end of frames is reached, and then frames are read from the video file. After obtaining the frames, the next step is to convert them into image files using the 'frame2im' command. The converted image will ultimately be saved. The extraction rate of frames is '30 frames per second. This step is required because videos cannot be processed directly. Figure 4.1 depicts the HAR system flowchart. Later, the BS method is used to identify the moving humans. In this method, a background image is considered, and each frame is subtracted from this background image to obtain foreground images containing the human region. The 'RGB' image of the foreground is converted to grayscale images. To remove noise components from the result, "2-D median filtering" is implemented.

- Once the noise has been taken out, grayscale images will be turned into binary images made up of zeros and ones, where binary 0 means there are no people in a white area and binary 1 means there are people in that white area. In order to get moving people or things out of a video, it is important to make a binary image. Following this, the dilation operation is performed on the obtained binary images. Measurements consist primarily of area, which provides the actual number of pixels present in the image region; bounding box, which represents a small rectangle box within which each individual human region exists; centroid, which determines the center pixel of each detected human; and many others. Upon completion of all tasks, both individuals and groups of people will be identified. "SVM classifier" is utilized in order to recognize human action. The primary step in developing a classifier is selecting training sets. Approximately seven distinct types of training folders are created in the present work. It includes actions such as walking, standing, handshakes, kicking, punching, hugging, and falling backward.

- The SVM classifier requires N (N-1)/2 training folders, where N is the total number of training folders. The "one-to-one strategy" is used for classification. When a sample is provided as input to the classifier during testing, if the output is positive, the group belongs to class A; otherwise, it belongs to class B.

- To make my research project successful, I studied the research paper mentioned above. According to what I learned from the first research paper, the robot mentioned there is capable of taking care of the child, but there is no way to capture the child's behaviors and convey that data to the parents.

- Also, through the second research paper, I learned a method of recognizing human behavior using artificial intelligence. By using such methods, I am able to apply the techniques to the part I develop in our research project.

## 1.2    Research Gap

Our group decided to focus a research project on some activities that have not received much attention so far, even though there are various robots to take care of children.

Among those activities, I focused on giving the robot we are creating the ability to understand the child's behavior and let the parents know about it even when they are far away. I have chosen to do this with the help of technologies like artificial intelligence and machine learning. I intend to use a text message or email to inform parents of their child's activities. Thus, by developing an alerting system, busy parents can pay attention to their children along with their duties.

## 1.3    Research Problem

With the busyness of many parents, their attention toward their children decreases. Therefore, it is very useful for parents to keep an eye on their children while doing their duties. Our group decided to do our research based on the answers we received regarding this problem. The solution we offer will enable parents to remotely monitor their child, gain insight into the child's external influences, be aware of the child's behavior that requires attention, and play music or communicate with the child. Our group plans to present four solutions to the primary problem.

In this instance, we decided to create a robot that can assist parents in meeting the needs of their children.

Beyond this basic problem, understanding the child's behavior cannot be gained from the child's mother or from any other location distant from the child. I intend to introduce a method for that. My proposed method was to design the robot that we are producing to recognize the behavior of the child and let the mother feel about the behavior, such as whether he is entering a dangerous area, kneels or falls.

## 1.4   Research Questions

- How can the child's behavior be identified?
- What behaviors should parents be aware of?
- How to educate parents about relevant behavior?
- How sensor data is collected?
- 

# 2   OBJECTVIES

## 2.1   Main Objectives

Creating an alerting system that can accurately detect the behavior of the child and inform the parents about it.

01) Informing parents through an alert when the child is about to enter a dangerous area.

02) Detects the child's behavior when he kneels or falls and alerts the parents through an alerting system.

**Novelty**- Capturing the child's behavior and providing an accurate alert to the parents.

## 2.2   Sub Objectives

Integrating with all team members in order to assemble the robot and develop the user interface.

# 3 METHODOLOGY

My plan was to use the robot we make to make a successful alerting system. Thus, a system that provides parents with information about their child's behavior wherever they are. When the infant is sleeping or crying, for instance, the robot can send a message to the parent. This alert system allows parents to know where and what their child is doing at all times. I believe this will be an efficient method for busy parents to provide child care.

Through this research, I have to pay attention to several basic functions. Basically, it is necessary to distinguish between the child's behavior and the behavior that should be felt by the parents. After that, attention should be paid to ways of identifying the behaviors that need to be sensed using sensors and related technologies.

Then the data obtained by the sensors should be programmed into the robot. After thinking about what kind of message to send as an alert, I decided to set up a method to send a message or email. I intend to alert the parents in this manner so that they can sense whether the infant is entering a dangerous area, kneels or falls etc.  In order to succeed in this research, I intend to study well about similar robots and conduct research related to these robots.

I have already mentioned some of the research papers that I have found so far. Further, I am working to study the technologies and methods related to this system with the maximum support that can be obtained from such funds and from our supervisor and co-supervisor. After preparing the alerting system in this manner, it must be tested with the mobile robot we manufacture to ensure its optimal operation.

## 3.1 Technologies

Below is a description of some grant technologies that I should pay attention to while creating this section.

**Sensors:** The robot would need sensors to detect toddlers' presence and track their movements. This may include cameras, motion detectors, and other sensors capable of detecting environmental changes.

**Machine learning**: The robot must be able to recognize and learn various objects and people, including toddlers. This would involve utilizing machine learning algorithms to analyze the sensor data.

**Artificial Intelligence:** The robot would require artificial intelligence in order to make decisions based on the data it collects and analyzes. This would necessitate the use of artificial intelligence to analyze the data and determine when to alert parents or caregivers.

## 3.2 Equipment and Purposes

| Equipment | Purpose |
|---|---|
| Camera | The camera can be used to identify the child's behaviors. |
| Motion sensors | When something moves, like a toddler kneeling or walking in a dangerous area, these sensors can pick up on it and set off an alarm to warn the parent. |
| Ultrasonic sensors | These sensors can detect obstacles or objects in the robot's path and activate a warning system to alert the child to potential danger. |

*Table 1 Equipment & Purposes*

### 3.3 Hardware Development

- o **Physical Design:** The robot should be designed to be child-friendly and have a cute and welcoming appearance to put the child at ease. The robot's design should be robust enough to withstand any incidents that may occur. The robot should also have wheels or some other form of locomotion so that it can travel around and follow the child.

- o **Sensors:** The robot should be fitted with a variety of sensors to detect the child's presence and movements. Included among these sensors are proximity sensors, infrared sensors, and cameras. The sensors should be strategically placed on the robot in order to provide complete coverage of the adjacent area.

- o **Alerting System:** The robot should be equipped with an alerting system that can advise the child of potential danger.

- o **Durability:** The robot must be constructed to withstand the wear and strain associated with interacting with children. It should be constructed of high-quality materials and be child-friendly and secure.

### 3.4 Software Development

- o **Machine Learning:** The software should be designed to learn the child's behavior patterns and movements in order to recognize when he or she is approaching a hazardous area or displaying dangerous behavior. This is possible with machine learning algorithms that analyze sensor data and recognize patterns.

- o **Object Recognition:** The software should be able to identify potentially hazardous objects or situations, such as open doors or sharp objects, in order to warn the child and prevent incidents. This is possible with image recognition algorithms that analyze camera data and identify potential hazards.

- o **Communication:** The software should be able to communicate with the alerting system and the sensors in order to activate the alerting system when required. I intend to use WIFI technology for this.

- o **User Interface:** The software should have an easy-to-use interface for parents to configure the robot and its parameters. This may be accomplished via a mobile application or a web-based interface. Therefore, we intend to use a mobile application for this.

# 4    TESTING AND EVALUATION

Throughout the development and implementation of this alerting system, extensive testing and evaluation will be conducted to ensure its effectiveness and dependability. The subsequent tests will be conducted:

## 4.1    System Functionality Test

This test will be conducted to ensure that the system can detect danger and alert caregivers. Additionally, the test will examine the alerts' precision and the system's response time.

## 4.2    User Acceptance Test

This evaluation will determine how well the system meets the requirements and expectations of the intended users, namely parents and caregivers. A sample group of users will be recruited to evaluate the system's usability, functionality, and design and provide feedback. The feedback will be utilized to make any necessary system adjustments and enhancements.

## 4.3    Performance Test

This test will evaluate the system's performance under various conditions, such as temperature and humidity. The test will make sure that the system works well in a variety of different environments.

## 4.4 Gantt Chart

| Task | Jan | Feb | March | April | May | June | July | Aug | Sep | Oct |
|---|---|---|---|---|---|---|---|---|---|---|
| Study and research the problems facing the parents. | ■ |  |  |  |  |  |  |  |  |  |
| Preparing a solution strategy for a proposed problem |  | ■ | ■ |  |  |  |  |  |  |  |
| Design the conceptual diagram and circuit diagram |  |  | ■ |  |  |  |  |  |  |  |
| The hardware for the robot will be designed. |  |  |  | ■ | ■ |  |  |  |  |  |
| Implementing Sensors to Detects the child's behaviors. |  |  |  |  |  | ■ |  |  |  |  |
| Implementing the sensors for alerting system |  |  |  |  |  |  | ■ |  |  |  |
| Implementing WIFI connection to connect mobile app and the robot. . |  |  |  |  |  |  | ■ |  |  |  |
| Implement the coding part and design the GUI interface. |  |  |  |  |  |  |  | ■ | ■ |  |
| Testing the system |  |  |  |  |  |  |  | ■ | ■ |  |
| Present the system |  |  |  |  |  |  |  |  |  | ■ |
| Month | Jan | Feb | March | April | May | June | July | Aug | Sep | Oct |

# 5 Conclusion

A baby monitoring system is the best way for parents to keep a watch on their children in today's hectic environment. It is merely a technological application that has no influence on the parents' daily activities. As stated in the introduction, our goal is to design a monitoring system that offers a high level of infant safety and a novel security method. Moreover, the Arduino nano is a low-cost processor that can make the system more cost-effective than current alternatives. This technology can output both audio and video simultaneously. It can be used at home and when caring for newborns. By employing this strategy effectively, parents' tedium and anxiety can be alleviated. Additionally, this strategy supports the baby's protection concern. This system is presently operational, but it can still be upgraded and improved

# 6 References

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