Have you heard of Industry 4.0 or Intelligent Manufacturing? Right now, the manufacturing industry is undergoing a major revolution. With advanced technology, we can produce goods at incredible speeds and with exceptional quality. Autonomous Mobile Robots, or AMRs, are playing a critical role in this transformation. Why? Primarily because AMRs reduce labor costs and significantly increase production efficiency. Beyond manufacturing, AMRs are also being used in fields like healthcare and the military. In fact, reports suggest that the AMR market is expected to grow by 25% from now until 2029. It’s clear that these robots will reshape how we work in the near future.

However, this technological shift brings challenges. In the future, many people will need to work alongside AMRs—not only in high-tech factories but also in hotels, restaurants, and even on the streets. For these robots to function effectively in such environments, they must be able to avoid people, cars, and other moving obstacles. Unfortunately, even today’s most advanced AMRs struggle with dynamic environments, which reveals a significant limitation in their navigation systems. This is an area where improvements are still needed.

My research focuses on developing an improved obstacle-avoidance algorithm for a specific type of mobile robot called the General Bicycle Model (GBM). Similar to bicycles, this robot has two wheels. However, unlike regular bicycles that steer by turning the front wheel, the GBM’s two wheels can rotate independently. This design allows the robot to move in any direction without changing its orientation—similar to how a crab moves. This flexibility makes it highly maneuverable.

But how can we make the GBM avoid obstacles on its own and reach its destination safely? The solution lies in helping the robot develop a kind of "special awareness." This means the robot must continuously observe obstacles around it, assess the risk of collisions, and adjust its path to minimize those risks. To find the safest route, the GBM must make decisions on the go and refine them in real-time.

However, giving a robot the ability to evaluate risks requires solving complex mathematical equations. These equations describe the risk factors and constraints in its environment. The challenge is that solving intricate equations can slow down the robot’s computer, causing delays in decision-making. In some cases, the robot might even get stuck, which could lead to dangerous situations. To prevent this, my current focus is on simplifying the mathematical functions the robot uses to make decisions.

If we can overcome this challenge, we will move one step closer to achieving fully autonomous AMRs. With better navigation systems, these robots could safely and efficiently operate in complex environments, bringing us closer to a future where AMRs are a seamless part of everyday life.